Comparison Effectiveness of Custom-Made Versus Conventional Aluminum Splint for Distal Phalange Injury

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Background: Finger splint is a simple and common method for finger immobilization. The flexible aluminum foam-padded splint is a convenient off-the-shelf inexpensive splint. But there’re some studies favor expensively custom-made thermoplastic splint due to its less likely result in treatment failure. Therefore the authors have modified the conventional aluminum finger splint in the foam-padded part to improve the fitting and compliance of the patients.

Objective: To compare the fitting of custom-made aluminum finger splint with conventional aluminum finger splint.

Material and Method: Sixty volunteers were randomized to apply 30 conventional or custom-made aluminum splints on 4th digit in non dominated hand for one week. The fitting of each splint was measured by displacement of the splint between initial placement and one week later. Patient satisfaction and pain was measured by visual analog score (VAS).

Results: The slip and deviation in custom-made group were less than the conventional group significantly (mean of slip 0.86 mm vs. 2.23 mm, p < 0.001, mean of deviation 1.1 degrees vs. 2.23 degrees, p < 0.001) but the longitudinal migration was not significantly difference between both groups (mean 1.6 mm in custom-made group vs. 1.46 mm in conventional group, p = 0.67). The patient satisfaction demonstrated no significant difference between both groups (mean VAS 7.76 in custom-made group vs. 7.3 in conventional group, p = 0.31). Two patients terminated from the present study before one week in custom-made group and one patient in the conventional group (6.67% vs. 3.33%, p = 0.554).

Conclusion: The custom-made aluminum finger splint can improve the fitting to the finger pulp. However, patient satisfaction and compliance are not significantly different between both groups.

Keywords: Custom-made aluminum finger splint, Randomized controlled trial, Mallet finger, Fingertip injury

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Finger splint is a simple method of immobilization for common finger injury, such as, distal phalange fracture, nail bed injury, finger tip injury and mallet finger. The purpose of splintage is to prevent re-injury and maintain alignment to facilitate bone and soft tissue healing. However, there’re some conditions that require longer time of immobilization, such as mallet finger which the finger splint must be worn continuously for at least 6 weeks(1). Although external splinting is the treatment of choice for uncomplicated mallet finger(2), the major problems of treatment failure were due to patient compliance(3) and skin-related complications(4). So there’re several types of finger splint have been done as a custom-made splint to improve in fitting, compliance and skin-related complications(5-7). The flexible aluminum foam-padded splint is a convenient off-the-shelf inexpensive splint that can be provided in many width sizes and easily adjusted to each patient’s fingers. But some recent RCT studies found a trend in favor of custom-made thermoplastic splint due to its less likely result in treatment failure(6,7). However, custom-made thermoplastic splint is quite more expensive and unavailable especially in municipal hospital. Therefore the authors have modified the conventional aluminum finger splint especially in the foam-padded part to improve the fitting and compliance of the patients with the purpose that this technique can be easily done even by general practice physicians.

The present study aimed to compare the fitting and patient satisfaction between new custom-made aluminum finger splint and conventional finger splint. To test for the safety and efficacy of the new modified
splint before using with the patients, so the author’s
designed the present study in volunteers with the
shorter time of splinting. The authors hypothesized
that the custom-made aluminum finger splint would
demonstrate superior fitting and satisfaction to the
conventional finger splint.

Material and Method

The custom-made foam-padded aluminum finger splints were done by modification of 0.75 inch aluminum splint (Alumafoam finger splints, Leadermed Ltd., Bangkok, Thailand) in the foam-padded part. First step, place patient’s finger on the foam-padded to approximate size of foam removal (Fig. 1A-B). Then, cut the foam-padded along the marker and carve into a semicircular groove along the longitudinal axis of the splint (Fig. 1C-D) with the curve-tip wooden carving knife until it fit with the patient finger pulp (Fig. 2).

Sixty volunteers with normal hands were randomized equally into 2 groups, the custom-made splint and conventional splint group.

Thirty volunteers in the conventional splint group were applied with the 0.75 inch foam-padded aluminum finger splint on the volar aspect of the distal interphalangeal joint of non-dominant hand ring finger. With ensured extension from middle phalange to distal phalange and allowed fully flexion of the proximal interphalangeal joint. Then 0.5 inch Micropore™ (3M™) tape was applied to fit the splint with middle and distal phalange respectively (Fig. 3). Other thirty volunteers in the custom-made splint group would be applied in the same fashion with the modified semi-circular groove foam-padded finger splint.

The skin markings were performed with the permanent color pen adjacent to every borders of the splint. Every volunteer would be instructed to maintain and keep the splint dry. After one week, each volunteer would be evaluated. If the splint was lost, the volunteer will be just as non-compliance. The displacement was measured in three axes. Firstly, the proximal-distal migration along the longitudinal axis of the splint was measured by the distance from the marking line to the proximal border of the splint (Fig. 4; PD distance). Secondly, the lateral slip on coronal plane was measured by the maximum perpendicular distance from the lateral marking line to the lateral border of the splint (Fig. 4; L distance). Thirdly, the coronal deviation was measured by the degree of angulations between midline axis of the finger and midline axis of the splint which adjusted to 0 degree at the beginning of the study (Fig. 4; C angle).

The patient satisfaction was measured with visual analog score (VAS). The volunteers

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Fig. 1  (A)The conventional foam-padded aluminum splint; (B)Measure and mark size of patient finger pulp; (C)Cut and carve the middle portion of foam-padded according to patient pulp shape; (D)Custom-made splint after removed of middle portion foam-padded

Fig. 2  Straight and curve tip wooden carving knives
The coronal deviation was measured by the angulations (C angle) between the midline axis of the finger (black dash line) and the midline axis of the splint (white dash line).

**Results**

The data of both groups was shown as Table 1. The mean age of both groups were not statistically significant different (mean age custom-made group $26.24 \pm 4.27$ yrs. vs. conventional group $25.74 \pm 4.74$ yrs., $p = 0.67$).

There’re two non-compliance patients in custom-made group and one patient in conventional group (6.67% vs. 3.33%, $p = 0.554$). The cause that all volunteers terminated from the present study is the feeling that the splint is too tight.

The mean age, migration, lateral slip, coronal deviation angle, patient satisfaction and non-compliance patient were shown as Table 1.

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Fig. 3 (A) Lateral view of finger after applied an aluminum splint; (B) Frontal view of conventional aluminum splint; (C) Frontal view of custom-made splint

Fig. 4 The proximal-distal migration (PD distance) was measured by the maximum perpendicular distance between the marking line (black dot line) and the proximal border of the splint (white dot line)

Fig. 5 The lateral slip (L distance) was measured by maximum perpendicular distance from the lateral marking line (black dot line) to the lateral border of the splint (white dot line)
Discussion

Finger splint is the effective treatment of choice for simple mallet finger injury. Although most of the studies report good result of finger splinting but they also report skin related complications range from skin irritation, skin maceration, dorsal skin ulcer and nail deformity with the incidence varied from $3\%$ \(^{(8)}\) to $33\%$ \(^{(9)}\) depended on type of splint and treatment protocol. Moreover patient compliance is one of the major problems \(^{(3)}\) that results in treatment failure due to patients cannot tolerate the splint with the treatment period at least 6 weeks. These problems are seem to be higher in the closed-type splint such as non-perforated plastic Stack splint \(^{(9)}\) and splints that are less adjustable to the size and shape of the finger \(^{(8)}\). Even though there’s no report of skin-related complication incidence from tropical zone countries, such as Thailand, but from the authors’ experience the skin-related complications from mallet finger treatments are quite common and due to the hot and humidified weather, there’re very few patients that can tolerate closed-type finger splint for a long time. So the authors preferred the foam-padded aluminum malleable splint for mallet finger treatment and change new splint every week for at least 6 weeks. To enhance the fitting of the splint and patient compliance, the authors modified the conventional splint with the semicircular groove in the middle part of foam-padded to increase the stability especially in coronal plane and decrease the pressure on the pulp of the finger.

From the result of the pilot study in normal hands, the modification of the foam-padded aluminum splint can decreased the lateral slip distance and coronal deviation angle significantly compared to the conventional splint. Although the amplitude of slip and deviation may not clinically significant but it can prove that this modification can improve fitting of the foam-padded aluminum splint with quite easy technique that can be done without other sophisticated tools. However, the authors cannot found difference in patient satisfaction, compliance and skin-related complications between both groups. These possibly will be due to the short period of intervention and the present study was not done in the injury fingers that patients usually have pain, swelling and potential to skin-related complications.

As the result of the present study, the authors can use this custom-made aluminum finger splint as the alternative treatment of conventional finger splint. Further more, the authors would like to conduct the present study in using this splint in acute mallet finger injury patients to find out whether this modification can improve comfortable and compliance in the patients.

Conclusion

The authors’ custom-made aluminum finger splint is a simple modification of conventional aluminum finger splint that can improve fitting by decrease lateral slip and coronal deviation. But patient satisfaction, compliance and complications are not statistically different between both groups.

Potential conflicts of interest

None.

References

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การศึกษาเปรียบเทียบประสิทธิภาพการใช้อุปกรณ์แบบเฉพาะบุคคลกับอุปกรณ์แบบนิ้วอุปกรณ์แบบทั่วไปสำหรับการบาดเจ็บกระดูกส่วนปลายนิ้ว

ภูมิหลัง: การใช้อุปกรณ์เป็นการรักษาที่พบได้บ่อยสำหรับการรักษาบาดเจ็บของปลายนิ้วมือ เนื่องจากสามารถทำได้ง่ายและมีอุปกรณ์ให้เลือกใช้หลากหลาย เพื่อให้เหมาะสมกับผู้ป่วยและสามารถสนับสนุนการรักษาได้ ทั้งนี้อุปกรณ์แบบนิ้วอลูมิเนียมแบบทั่วไปเป็นอุปกรณ์ที่มีทั่วไปทั่วโลกและมีราคาถูก แต่มีการศึกษาพบว่า คุณสมบัติของอุปกรณ์แบบนิ้วอลูมิเนียมที่ทำจากโลหะสัมผัสกับผู้ป่วยอาจทำให้ผู้ป่วยรู้สึกไม่สบาย และอุปกรณ์แบบนิ้วอลูมิเนียมที่มีราคาแพงและไม่แพร่หลายโดยเฉพาะในโรงพยาบาลขนาดเล็ก ดังนั้นคณะผู้นิพนธ์จึงได้พัฒนาการจัดหาและออกแบบอุปกรณ์แบบนิ้วอลูมิเนียมแบบทั่วไป เพื่อให้เหมาะสมกับผู้ป่วยแต่ละคนมากขึ้น

วัตถุประสงค์: เพื่อเปรียบเทียบความพอดีของอุปกรณ์แบบเฉพาะบุคคลกับอุปกรณ์แบบนิ้วอุปกรณ์แบบทั่วไป วิสัยและวิธีการ: ทำการสุ่มอาสาสมัครจำนวน 60 คน ออกเป็นกลุ่มเท่าๆกัน ได้แก่กลุ่มอุปกรณ์แบบเฉพาะบุคคลกับกลุ่มอุปกรณ์แบบทั่วไป จากนั้นทำการสอบถามความพอดีของอุปกรณ์แบบนิ้วอลูมิเนียมแบบทั่วไป ของอาสาสมัครในแต่ละกลุ่ม แล้ววัดมุมการเคลื่อนไหวในระดับต่างๆ ของการรักษา และวัดความพึงพอใจต่อการรักษา

ผลการศึกษา: พบว่าอุปกรณ์แบบเฉพาะบุคคลมีการเคลื่อนไหวในระดับต่างๆมากกว่าอุปกรณ์แบบทั่วไป โดยมีค่า p < 0.001 แต่ผลสัมพันธ์ไม่มีความแตกต่างกันอย่างมีนัยสัมพันธ์ทางสถิติ (ค่าเสถียรภาพของค่าเดิมที่ 0.86 มม. กับ 2.23 มม. คา p < 0.001, คาเสถียรภาพมีการลดต่ำ 1.1 องศา กับ 2.23 องศา คา p < 0.001) แต่ผลสัมพันธ์ไม่มีความแตกต่างกันอย่างมีนัยสัมพันธ์ทางสถิติที่สำคัญ ต่อการทำงานที่เป็นไปตามแผนงานนี้ ความพึงพอใจของการรักษา และ จำนวนอาสาสมัครที่ขอออกจากการศึกษาถูกกำหนด ในอนาคตจะต้องติดตามการใช้อุปกรณ์แบบนี้ในการศึกษานี้

สรุป: อุปกรณ์แบบเฉพาะบุคคลแสดงได้รับความพอดีมากกว่าอุปกรณ์แบบทั่วไปของอาสาสมัคร โดยมีความแตกต่างกับอุปกรณ์แบบนิ้วอุปกรณ์แบบทั่วไป แต่ไม่พบความแตกต่างทางสถิติ

References: