

Case Report

Comminuted Rolando's Fractures: Treatment with Modified Wrist External Fixator and Transmetacarpal Pinning

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Background: For comminuted Rolando's fracture, external fixation with early mobilization is the treatment of choice however, there is controversy in this treatment. Low-profile or mini external fixator can be used, but expense and availability of this kind of implant in Thailand has resulted in using various techniques of surgery. The purpose of this retrospective study was to present the authors' alternative technique with modified implants and the outcome in the management of comminuted Rolando's fracture.

Material and Method: The patients with comminuted Rolando's fracture were treated by using external fixation across the wrist (mostly by locally-made implants) between the radius and the first metacarpal and transmetacarpal K-wire fixation from the first to the second metacarpal.

Results: Between 1999 and 2005, six patients with a mean age of 25 years (range, 19-33 years) were studied. The average follow-up period was four months. Satisfactory reductions were achieved in all fractures. The average operation time was 27.5 minutes. All closed fractures united within six weeks and had satisfactory results, which was normal range of motion of thumbs and wrists and with no complications. Only one opened fracture caused by a gun shot injury was healed in eight weeks and had a mild degree of reflex sympathetic dystrophy.

Conclusion: Closed reduction and external fixation with modified wrist external fixator and transmetacarpal pinning is simple, safe, fast, and effective for the treatment of comminuted Rolando's fractures.

Keywords: Rolando's fracture, External fixator

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Rolando's Fracture is a comminuted intra-articular fracture of the base of the first metacarpal. In 1910, Sivio Rolando first described the series of 12 cases of classic T and Y shaped⁽¹⁾. However, all comminuted fractures of the base of the thumb were categorized in this group. Because of the axial loading and deforming force by extensor pollicis longus, adductor policis, and abductor policis longus⁽²⁾, Rolando's fracture is considered unstable and should be treated by surgery. Restoration of articular surface should be tried, even though the correlation of the posttraumatic arthritis

and quality of reduction are controversial⁽³⁻⁶⁾. Open reduction and internal fixation is preferred for the fractures with large fragments, while closed reduction with distraction using external fixation device is employed for comminuted fractures^(7,8). Previous studies reported the various techniques for the treatment of this kind of fracture using mini external fixator⁽⁹⁻¹³⁾. Due to the expense and availability of mini external fixation system in Thailand, the authors modified a locally-made wrist external fixator for the treatment of these fractures. This external fixation system is less expensive and more available. The purpose of the present study was to present the authors' technique and outcome of the modified wrist external fixator for the treatment of comminuted Rolando's fracture.

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Material and Method

Between 1999 and 2005, six patients sustained high-energy injuries and diagnosed with comminuted intra-articular fractures of the base of the thumb. They were treated at the department. All patients were operated on within one week after injury. Each fracture revealed three or more fragments of the articular surface. Three injuries involved the dominant right hand and three involved the non-dominant left hand. Five patients were men and one was a woman. Their average age was 25 years (range, 19-33 years).

Surgical technique

Closed reduction and distraction with wrist external fixator and transmetacarpal K-wire fixation from the first to the second metacarpal was done in all cases. Five Korat external fixation systems and one Aesculap system (B. Braun, Tuttlingen, Germany) were used.

The Korat system (Fig.1) was invented at Maharaj Nakorn Ratchasima Hospital, Nakorn Ratchasima province, as a low cost treatment for open fracture of the long bone in 1985⁽¹⁴⁾. The smaller system for fixation of the wrist was developed in 1990. This system is still inexpensive but has only two plane degrees of freedom. The rod must be bent applying for the angle of thumb abduction and palmar flexion prior to inserting the pins (Fig. 2). This model can create a distraction force along the axis of the first metacarpal.

Under regional anesthesia, the wrist was held in slightly extension position. The closed reduction

was performed by traction, abduction, flexion, and pronation of the thumb⁽¹⁵⁾. When acceptable reduction was obtained and confirmed under fluoroscopy, the 1.4 mm (0.054 inch) Kirschner wire was driven through the first metacarpal to the second metacarpal. The 3.5 mm proximal pins of external fixator were placed in the radius, using the same technique as the external fixation of the distal radius fracture⁽¹⁶⁾. The 4.0 mm rod was bent and applied with clamps. Then the distal pins were placed in the first metacarpal, just distal to the fracture, volarly and radially to the extensor pollicis brevis tendon (Fig. 3). In one case, the Aesculap external fixation system was used without bending the rods. Even this clamp has three plane degrees of freedom, there were some degrees of varus angulation at the fracture site after fixing four pins, so one more pin was added, and the frame was constructed into a Y shape to correct this angulation (Fig. 4).

Without other external support, the patients were instructed to do passive and gentle active range of motion exercises of their fingers regularly. The external fixators were removed after six weeks except one case with a gunshot injury; the fixator was removed after eight weeks. After removal of the fixator, active and passive range of motion exercises of the wrist was also initiated.

The patients were interviewed regarding pain, confidence of working, and function of carpometacarpal joint of the thumb. Physical exam was done to review the range of motion of the thumb and the



Fig. 1 Korat external fixator clamp
A = Mini clamp
B = Standard size clamp



Fig. 2 Transmetacarpal K-wire and Korat external fixator was placed, the rod must be bent to contour with abduction and flexion axis of the thumb



Fig. 3 Patient No.5, who was shot by an 11 mm gun on her left hand
 A = preoperative radiograph shows comminuted fracture of the base of the first metacarpal
 B = The fracture was reduced and stabilized with transmetacarpal K-wire and external fixator
 C = Clinical figure demonstrates the application of Korat external fixator

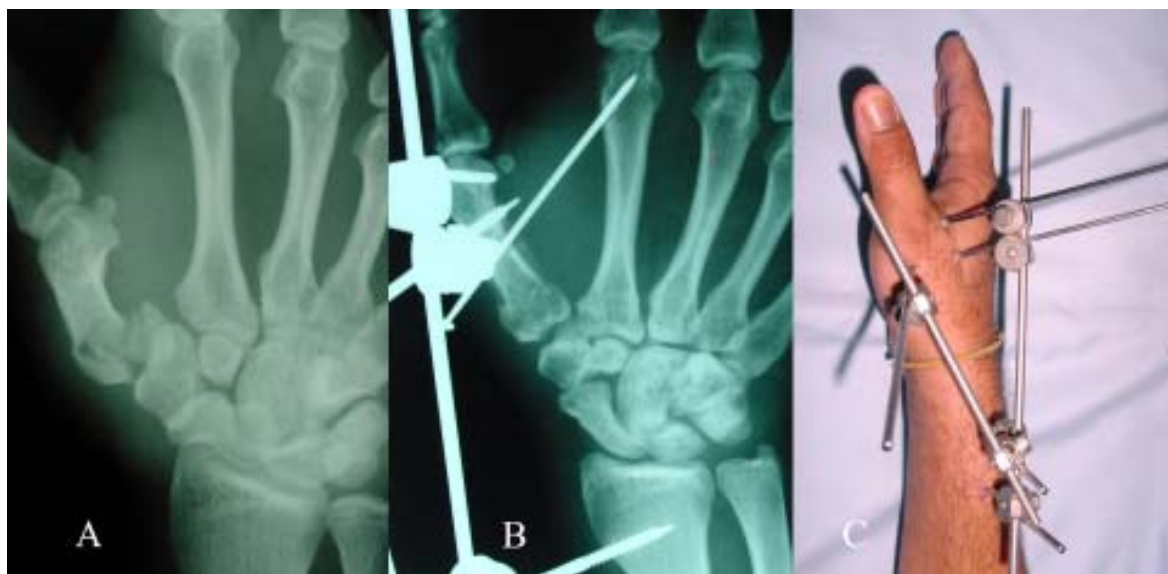


Fig. 4 Patient No.4 who fell on his right thumb
 A = preoperative radiograph demonstrates comminuted fracture dislocation of carpometacarpal joint of the thumb
 B = The fracture was reduced and fixed with transmetacarpal K-wire and Aesculap External fixator
 C = Clinical figure revealed the Y-shape constructed of external fixator

existence of deformities and compared to the contralateral side. Postero-anterior and true lateral radiographs were taken at each visit. All were evaluated with the average follow-up period of four months (range, 3 to 6 months).

Results

Five patients complained of occasional slight discomfort, but were free of pain. All could start working with confidence. One patient, who sustained a gunshot injury, had a moderate degree of pain and

Table 1. Details of the patients of Rolando's fracture

Patients	Age	Sex	Affected hand	Cause	Type of external fixator	Operative time (mins)	Quality of reduction	Follow up time (months)	Results**	Complications***
1	24	M	Rt	traffic	Korat	30	satisfactory	3	Good	No
2	23	M	Rt	traffic	Korat	30	satisfactory	3	Good	No
3	19	M	Lt	traffic	Korat	25	satisfactory	6	Good	No
4	33	M	Rt	fall	Aesculap	30	satisfactory	3	Good	No
5	20	F	Lt	Gun shot	Korat	25	satisfactory	6	Fair	RSD
6	31	M	Lt	traffic	Korat	25	satisfactory	3	Good	No

* Satisfactory reductions are joint stepping < 1mm and axis of the shaft of 1st metacarpal was aligned with in the axis of trapezium⁽²⁾

** The results based on range of motion of the thumb and wrist joint compared to the normal side⁽¹⁷⁾

*** Complications were pin tract infection, loosening, injury to the branch of superficial radial nerve, and reflex sympathetic dystrophy

developed mild degree of reflex sympathetic dystrophy (RSD). These symptoms were resolved within six months. There were no deformities seen in all patients.

Stiffness or restricted mobility of the injured thumb, as measured by active palmar and radial abduction and opposition when compared with the uninjured side, was not seen in five patients. The patient who developed RSD had mild restriction of thumb opposition and thumb interphalangeal joint motion. This limitation had recovered at last visit (6 months).

Superficial radial nerve, radial and ulnar digital nerve functions of the thumb were normal in all patients. Motor function of the thumb, abductor pollicis brevis and longus, extensor pollicis brevis and longus, and flexor pollicis longus, were normal of grade M5 by the British Research Council grading system.

The average operative time was 27.5 minutes. Interval radiographs demonstrated satisfactory reductions in all six fractures (Table 1). Five closed fractures united within six weeks and had satisfactory results. One patient, who suffered from a gunshot injury, took eight weeks to heal. No second operations were required.

Discussion

There have been several reports of Rolando's fractures treated by various techniques of external fixation. Schuind⁽¹⁰⁾ reported three cases of fracture base of thumb metacarpal treated by distraction triangular fixator from the radius to the first and the second metacarpal bone. Bucher⁽¹¹⁾ reported 13 cases using the combination of limited internal fixation and intermetacarpal external fixator. Probasta⁽¹²⁾ reported five cases treated with mini external fixator between the trapezium and the first metacarpal. Kontakis⁽¹³⁾ used the same technique as Probasta but using only one pin instead of two pins in the trapezium. All results of these studies were satisfactory. Because this mini-external fixation system is not available in Thailand, the authors applied the new technique by using a modified, locally made wrist external fixator. The Korat external fixation system was used in five of six cases. To apply this system, which has only two plane degrees of freedom, the authors bent the rod curved to the angle of thumb abduction and flexion. This configuration can create the distraction force to align within the axis of the first metacarpal and trapezium.

Transmetacarpal K-wire fixation was used for the treatment of Rolando's fracture⁽¹⁸⁾, but this

technique cannot provide rigid fixation and external support was needed. The authors used this technique as fixation before applying the external fixator. This technique can prevent the loss of reduction while applying the external fixator, thus making the surgery much easier. Moreover, its construct also contributes the rotational stability and takes action as a secondary stabilizer for the fractures.

For intra-articular fracture of the base of thumb, there are still controversies regarding the correlation of the quality of reduction and post traumatic osteoarthritis⁽³⁻⁶⁾. It is generally accepted that perfect anatomic reduction is not necessary, but the joint surface should be reduced to less than 1 mm step-off to prevent the risk of radiographic arthritis⁽²⁾. The shaft of the first metacarpal should be reduced to realign with the trapezium to prevent abduction loss⁽¹⁷⁾.

With the authors' technique, the fracture was reduced to overcome these criteria easily. The external fixator can then be applied quickly. The patient can mobilize all finger joints and thumb interphalangeal joint freely. This can reduce the problems of stiffness. The disadvantage of the present method is that the fixator has to be fixed across the wrist joint, thus resulting in the possibility of joint stiffness. However, this complication was not found in all the presented cases. All patients usually gain normal range of motion after practicing physical therapy for six weeks.

The other drawback of the present study is the short follow-up periods. Because all the presented patients came from rural areas to work in factories near the authors' hospital, they mostly returned to their hometown after they got injured and treated, and were lost to follow-up.

Conclusion

The authors' technique of closed reduction and external fixation of comminuted Rolando's fracture, using, modified-wrist and external fixation combined with transmetacarpal pinning, is simple, safe, fast, convenient, and effective. This procedure might offer an alternative treatment of comminuted Rolando's fracture.

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กระดูกฝ่ามือหักชนิดโรแลนด์ รักษาโดยใช้การดัดแปลงเครื่องตามกระดูกจากภายนอกของข้อมือ ร่วมกับการใช้ลวดยึดระหว่างกระดูกฝ่ามือของนิ้วหัวแม่มือและนิ้วชี้

สัญญาณ เนียมปุก, ธนพงษ์ ไชยยะวิญญู

วัตถุประสงค์: เพื่อแสดงวิธีการผ่าตัดและศึกษาผลของการรักษากระดูกฝ่ามือหักแบบแตกละเอียดชนิดโรแลนด์ โดยใช้เครื่องตามกระดูกจากภายนอกร่วมกับการยิงลวดยึดระหว่างกระดูกฝ่ามือของนิ้วหัวแม่มือและนิ้วชี้

วัสดุและวิธีการ: ผู้ป่วยที่ได้รับการวินิจฉัยว่าเป็นกระดูกฝ่ามือหักชนิดโรแลนด์ที่แตกละเอียดจำนวน 6 รายที่มารับการรักษาที่โรงพยาบาลธรรมศาสตร์ระหว่างปี พ.ศ. 2542 ถึง ปี พ.ศ.2548 ได้รับการรักษาโดยการจัดกระดูกให้เข้าที่และยิงลวดขนาด 1.4 มิลลิเมตร (0.054 นิ้ว) ยึดกระดูกฝ่ามือของนิ้วหัวแม่มือไปยังกระดูกฝ่ามือของนิ้วชี้ และทำการยึดตรึงกระดูกฝ่ามือของนิ้วหัวแม่มือกับกระดูกเรเดียส ด้วยเครื่องตามกระดูกจากภายนอกที่ใช้สำหรับยึดกระดูกเรเดียสส่วนปลายหักชนิด ไคราช จำนวน 5 ราย และ AESCULAP จำนวน 1 ราย ผู้ป่วยทั้ง 6 รายมีอายุเฉลี่ย 25 ปี (พิสัย 19-33ปี) มีระยะเวลาของการติดตามผลการรักษา 4 เดือน(พิสัย 3-6 เดือน)

ผลการรักษา: สามารถจัดกระดูกให้เข้าที่ได้สำเร็จในผู้ป่วยทุกราย โดยใช้เวลาเฉลี่ยในการทำผ่าตัดน้อยกว่า 27.5 นาที ผู้ป่วยห้ารายมีกระดูกติดภายในหกสัปดาห์ และไม่มีผลแทรกซ้อน ผู้ป่วยหนึ่งรายที่กระดูกฝ่ามือหักแบบมีแผลเปิดที่เกิดจากการถูกยิง มีกระดูกติดในแปดสัปดาห์และมีอาการแปรปรวนของระบบประสาทอัตโนมัติ sympathetic (reflex sympathetic dystrophy) อย่างอ่อน ผู้ป่วยทุกรายมีการเคลื่อนไหวของนิ้วเป็นปกติโดยไม่มีอาการเจ็บปวด

สรุป: การจัดกระดูกให้เข้าที่ร่วมกับการใช้ลวดยึดระหว่างกระดูกฝ่ามือของนิ้วหัวแม่มือและนิ้วชี้ ร่วมกับการใช้เครื่องตามกระดูกจากภายนอกของข้อมือสามารถนำมาใช้รักษากระดูกฝ่ามือหักชนิดโรแลนด์ที่แตกละเอียดได้ ซึ่งเป็นวิธีที่ทำงานง่าย ปลอดภัย รวดเร็วและได้ผลดี
