Дж. А. Бертелли

ПРОКСИМАЛЬНЫЙ МЕЖФАЛАНГОВЫЙ ПЕРФОРАТОРНЫЙ ЛОСКУТ

Центр биологических наук о здоровье, Университет Южной Санта Катарины, Бразилия

Ключевые слова: *перфораторный лоскут, межфаланговый сустав.*

УДК 616.5-089.843-74-031:611.977:616.727.9:001.894

КЛАССИФИКАЦИЯ

Осевой кожный лоскут.

СОСУДИСТАЯ НОЖКА

Перфоратор до 0,4 мм в диаметре образуется из собственной пальцевой артерии на 10 мм проксимальнее проксимального межфалангового сустава (ПМФС). Вторичная васкуляризация происходит от сосудистой дуги (аркады) по краю сухожилия разгибателя (рис. 1)*.

АНАТОМИЯ И ПОВЕРХНОСТЬ МАРКИРОВКИ

1. Определяется объем кожного лоскута захватом кожи над ПМФС, который может быть поднят с одновременным закрытием раны (рис. 2).
2. Отмечается основная точка выхода питающей ножки лоскута (т. е. 10 мм проксимальнее ПМФС) (рис. 3).
3. Ориентиром для рассечения кожи служат отмеченные вторичные сосудистые пучки, которые проходят вдоль латерального края сухожилий разгибателей (рис. 3).
4. Отмечается точка соединения ладонной и тыльной поверхностей кожи, являющаяся границей рассечения кожи по ладонной поверхности.

ПОЛОЖЕНИЕ ПАЦИЕНТА

Положение на спине, верхняя конечность отведена под прямым углом, обработана, наложен жгут.

ПОДЪЕМ ЛОСКУТА

После удаления рубца на ладонной поверхности пальца измеряем дефект кожи. По тыльной поверхности области ПМФС выполняем разрез кожи до фасции, которая должна остаться на месте. Кожа отделяется от подкожной клетчатки и рассекается продольно до 10–15 мм параллельно краю сухожилия разгибателя по направлению к пястно-фаланговому суставу (ПФС) (рис. 4). Рассечение проводим до границы ладонной и тыльной поверхностей кожи. Лоскут переносится к ладонной зоне дефекта, фиксируется швами. Донорская зона полностью ушивается. Гипсовая иммобилизация — до 10 дней после операции с разгибанием ПМФС. После этого периода пациенту рекомендуется постепенно сгибать палец.

КЛИНИЧЕСКАЯ ПЕРСПЕКТИВА

Закрывается кожей дефект ладонной поверхности ПМФС (рис. 5).

РЕКОМЕНДАЦИИ

Этот несвободный лоскут не должен захватывать кожу по латеральной поверхности с противоположной стороны для сохранения венозного дренажа дистальной фаланги пальца (рис. 6).

*Рисунки представлены в английской версии статьи.

ЛИТЕРАТУРА

1. Bertelli J. A., Pagliei A. Direct and reversed flow proximal phalangeal island flaps. J Hand Surg Am 1994;19:671-680.
2. Bertelli J., Nogueira C. Treatment of recurrent digital scar contracture in paediatric patients by proximal phalangeal island flap. Ann Chir Main Memb Super1997;16:310-315.

ПОДПИСИ К РИСУНКАМ

Рис. 1. Анатомическое исследование латеральной поверхности указательного пальца после инъекции зеленым латексом плечевой артерии. Перфораторы расположены 10–15 мм проксимальнее ПМФС. Сосудистые дуги по краю сухожилия разгибателя имеют связи с перфораторами.

Рис. 2. Определение границ кожного лоскута для возможности полного ушивания раны.

Рис. 3. Модель лоскута с сосудистой ножкой, включающая дистальный перфоратор и подкожную клетчатку на стороне пальца.

Рис. 4. Схематическое представление подъема лоскута. Лоскут выделяется до поверхностной фасции. У основания лоскута кожа отделяется от подкожной клетчатки, которая рассекается по латеральному краю сухожилия разгибателя.

Рис. 5. Представление клинического случая. В левом верхнем углу: рубцовое втяжение после ожоговой травмы у ребенка до операции. В правом верхнем углу: интраоперационный вид выделенного перфораторного лоскута на указательном и среднем пальцах. Левый и правый нижние углы: кисть через 12 месяцев после операции.

Рис. 6. Схематическое представление дистальной границы лоскута. Кожа сохранена по латеральной поверхности пальца для профилактики нарушения венозного оттока от дистальной фаланги пальца.

Поступила в редакцию 23.03.2011
Утверждена к печати 1.06.2011

Перевод:

Митрофанова М. С. — соискатель кафедры оперативной хирургии и топографической анатомии им. Э. Г. Салищева ГОУ ВПО СибГМУ Минздравсоцразвития России, г. Томск.

Серяков В. И. — канд. мед. наук, врач-хирург АНО «НИИ микрохирургии ТНЦ СО РАМН», г. Томск.

Контакты:

Серяков Виктор Иванович
e-mail: vizor76@sibmail.com

C. P. Tacca, J. R. Rost, J. A. Bertelli, P. Myashita

SURGICAL TREATMENT OF RADIAL HEAD FRACTURES WITH HEADLESS SCREWS

Celso Ramos Hospital, Department of Orthopedics,
Hand and Elbow Surgery Service, Florianópolis, SC, Brazil

This prospective study was an evaluation of the functional results in 42 elbows that underwent surgical treatment for Mason II fractures of the radial head.

Forty-one patients with a combined 42 radial head fractures (one patient had bilateral fractures) were treated with open reduction and internal fixation, using headless screws. The evaluation of functional results entailed goniometry, and gauging the force of palmar prehension and thumb pinch, in addition to using the criteria proposed by Broberg and Morrey, between 30 and 90 days post-operatively.

All the fractures consolidated, with patients returning to their usual work activities within an average of 38.4 days. Range of motion and strength were greater than 90 % those of the uninvolved contralateral side.

The studied technique is an appropriate method for surgical treatment of Mason II radial head fractures, being minimally invasive and allowing for a rapid return to work and good function.
Key Words: *radial head fracture, open reduction, internal fixation.*

УДК 616.717.51-001.5-089.844-74:615.465:669-428.2:001.894

INTRODUCTION

Radial head fractures are the most common elbow fracture seen in adults, comprising 1,7 % to 5,4 % of all adult fractures and 33 % of all elbow fractures. Eighty-five percent occur in young to middle-age adults, in the age group from 20 to 60 years. The proportion of men to women is roughly two to one. These fractures can happen alone or in combination with other traumatic injuries, including lesions involving the medial collateral ligament, and fractures of the olecranon or the coronoid process of the ulna. It is believed that roughly 20 % of all cases of elbow trauma result in a radial head fracture[1].

Excision of the head of the radius without replacement creates instability of the distal radio-ulnar articulation and of the elbow, thereby interfering with daily activities. Other late complications are limitations of movement, cubitus valgus, dysfunction of the ulnar nerve, osteoarthritis, proximal migration of the radius, and subluxation of the distal radio-ulnar joint[2]. These complications have caused researchers to study elbow biomechanics, aiming to improve our understanding of the function of the head of the radius, not only at the elbow, but in the wrist and forearm. With lesions of the medial collateral ligament or the interosseous membrane, the stabilizer against compression forces and stress in valgus is the head of the radius. The development of novel techniques and internal fixation implants for the treatment of these fractures coincides with growing recognition of the important contribution of the radial head to elbow and forearm stability[3].

Recent studies have demonstrated the need to accomplish open reduction and internal fixation with Mason class II radial head fractures, to allow for early mobilization[4]. This fixation can be accomplished with a variety of materials, including mini-fragment screws, plates and headless screws, which are favoured in the absence of comminution of the radial neck[5].

In this study, we analyzed the surgical treatment of Mason II radial head fractures through open reduction and internal fixation using cannulated headless screws.

PATIENTS AND METHODS

The study was a prospective analysis of 42 surgical procedures performed to treat Mason II radial head fractures.

To be included in analysis, a patient had to be at least 16 years of age and have a modified Mason II (modified by Johnston) radial head fracture. Johnson's modification of Mason's classification scheme[6] (Figure 1) aims to quantify the extent of radial head involvement. Fractures are subdivided into type I, fractures of the radial head with inferior displacement to 2 mm; type II, fractures with superior displacement to 2 mm and involvement equal to or greater than 30 % of the joint surface; type III,

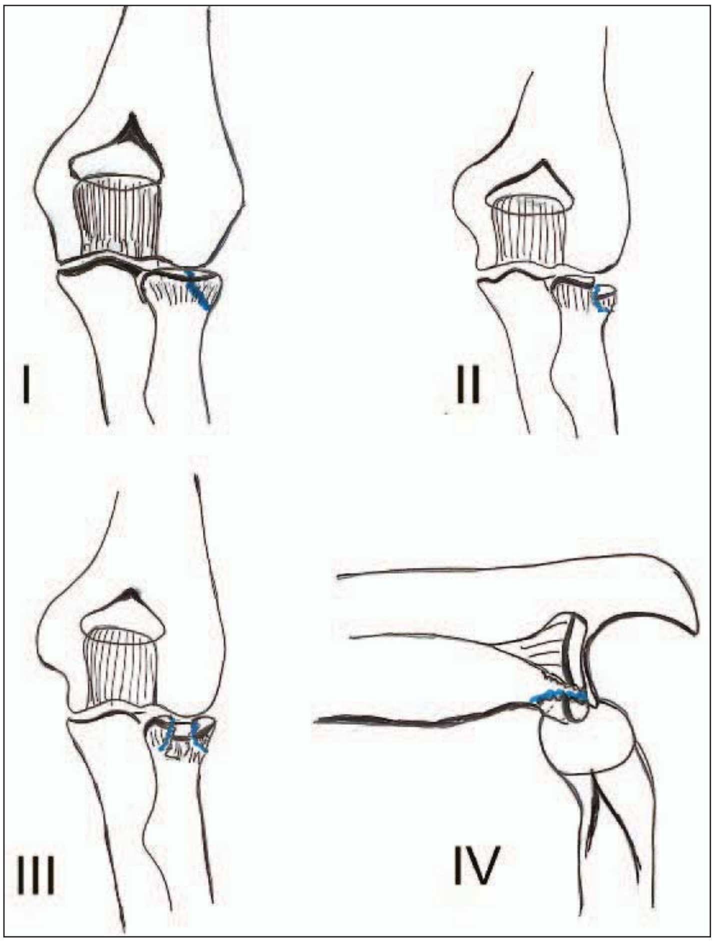

Figure 1. Mason's classification scheme for radial head fractures, as modified by Johnston

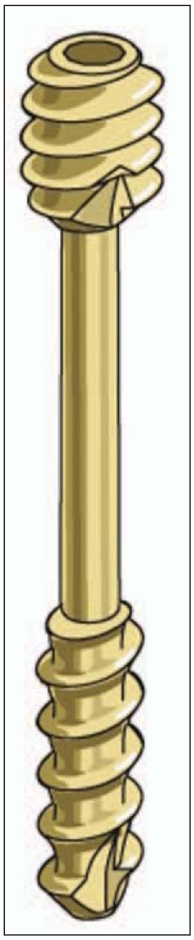

Figure 2: Cannulated headless screws

comminuted fractures; and type IV, fractures associated with concomitant elbow dislocation.

Exclusion criteria were: ligamentous injury at the elbow, as with an Essex-Lopresti fracture; an unstable Monteggia fracture; dislocation of the elbow; and any associated fractures the elbow (like fractures of the coronoid process, olecranon, or distal humerus).

In total, there were 41 patients who met the inclusion criteria — 23 males and 18 females – one of whom had bilateral radial head fractures. The age of patients ranged from 16 to 72 years, with a mean age of 43,2 years. The time elapsed between the initial trauma and reparative surgery ranged from 2 to 25 days, with an average of 9,5 days (±5,6). The mechanism of trauma was a fall onto an outstretched hand in 31 cases (73,8 %) and a fall directly onto the elbow in 11 cases (26,2 %). Patients were re-appraised immediately after surgery, and again at 30 and roughly 90 days after surgery. Thirty and nine patients had dexterous dominance. The involved elbow was on the right in 25 patients, and on the left in 15, with one patient having bilateral fractures. In terms of concomitant lesions, one patient presented with a malunion consolidated fracture of the distal radius on the ipsilateral side; 2 patients had a fracture of the distal radius that could be fixated during the same surgical procedure; and 2 had fractures of the ipsilateral scaphoid that was treated percutaneously with self-compressing screws during the same surgical procedure.

All patients were operated upon by the same surgeon, under brachial plexus block administered to the infra-clavicular space, guided by ultrasound. Patients underwent open reduction and internal fixation with cannulated headless screws (Figure 2). All patients underwent surgery between December 2007 and November 2009.

SURGICAL TECHNIQUES

Surgery was performed with the aid of a pneumatic tourniquet. Using an inflatable cuff to reduce bleeding, the upper limb was operated upon on an auxiliary table. We used the lateral approach proposed by Kocher, where we approached the fracture in the space between the anconeus muscle and the extensor carpi ulnaris to create an opening in the annular ligament and joint capsule. We maintained complete pronation of the forearm during dissection in the space of Kocher, because this moves the interosseous nerve out of the surgical field by at least 1 cm, according to Strachan and Ellis[7], thereby minimizing the risk of nerve trauma. After capsulotomy and opening of the annular ligament, we proceeded with reduction of the fracture.

Fracture reduction was accomplished through manipulation with a delicate osteotome for avoiding manipulation at the level of the radial neck to minimize the risk of impairing blood supply to the bone fragments. After anatomical reduction, we temporarily fastened the fracture with 0,9 mm Kirschner wires to allow for later definitive fixation with two cannulated headless screws. Using these screws for fixation, one should observe that the point of introduction of the screw has a minimum distance of twice the diameter of the head of the screw to the extreme of the fragment. The first screw should fasten the fragment with the cortex opposed to the head of the radius, while the second screw should fasten the fragment to the neck of the lateral radius, thereby stabilizing this fragment and avoiding rotation.

As for gauging the size of the screw to use, we adopted the following technique. When perforating the bone with the fine drill (used to create holes for the distal wire), when we felt counter-resistance from the cortex, we used a millimetre caliper to measure the residual length of the drill bit and then we decreased this distance by 30 mm (the maximum length of the drill), the difference coinciding with the size of the screw to be used. Soon afterwards, we carefully sutured the annular ligament with an anchored continuous stitch of mono-nylon 2-0. After releasing the tourniquet, we proceeded with rigorous hemostasis, and sutured the muscular interval between the extensor carpi ulnaris and anconeus, followed by the subcutaneous tissue and skin. The skin was sutured with a continuous intra-dermal stitch using absorbable thread. The limb then was immobilized in an axillo-palmar splint for 2 days after surgery. Postoperatively, all patients were monitored in hospital for pain and any complications of surgery, for at least 2 days prior to discharge (fig. 3–5).

POSTOPERATIVE FOLLOW-UP

At the time of the first follow-up visit, the splint was removed and the wound covered with just a strip of micropore adhesive. Physiotherapy was initiated, including supervised active exercises, guided initially by the surgeon to achieve enhanced movement and, later, strength. All patients were re-appraised 30 and 90 days postoperative, the repaired limb compared against the normal contralateral extremity. The clinical evaluation was conducted in accordance with Broberg Morrey's criteria(8) (Table 1). Evaluation included (a) the measurement of elbow and forearm range of motion, (b) the assessment of stability of the elbow, and (c) the identification of any patient complaints pertaining to the distal radio-ulnar joint. Goniometric measurements were performed using a standard goniometer, with elbow flexion and extension measured with the forearm in neutral rotation; and pronation and supination with the elbow in ninety degrees of flexion. The strength of palmar prehension was evaluated in three positions: with the elbow flexed 90 degrees; with the fist held in neutral and using a Jamar dynamometer; and pinching of the thumb with the wrist in neutral,

Table 1

Broberg and Morrey's Functional Index

Variable	Available Points
Range of Motion	
Flexion (0.2 × measured range)	27
Pronation (0.1 × measured range)	6
Supination (0.1 × measured range)	7
Strength	
Normal	20
Slight decrease (without functional limitations, 80% of the contralateral limb)	13
Moderate decrease (limits some activities, 50 % of the contralateral limb)	5
Marked decrease (considerable disability)	0
Joint Stability	
Normal	5
Slight instability (detectable, but without limitations)	4
Moderate instability (limits some activities)	2
Marked instability (considerable disability)	0
Pain	
No pain	35
Mild (with activity, not requiring medications)	28
Moderate (with activities or at rest)	15
Severe (constant, even at rest; chronic use of analgesics)	0

95–100 = excellent; 80–94 = good; 60–79 = fair; 0–59 = poor.

leaning against the table using a pinch-type dynamometer. X-rays of the elbow were obtained to assess radiocarpal and antero-posterior alignment, bone consolidation, and for consistency and reduction of the joint surfaces. A rehabilitation program was begun on the second postoperative day.

RESULTS

The duration of post-operative follow-up ranged from 3 to 29 months, with an average of 6.8 months (±3,6). The injured limb was dominant in 27 cases (65,8 %). All of the fractures achieved adequate consolidation. There were no cases of avascular necrosis; but, in two patient, late loss of the reduction occurred with a step equal to 2 mm. All patients returned to work; the mean time to return was 38,4 days (±16,2).

In terms of range of motion of the affected limb, we obtained mean flexion of 133° (±9,5), extension of 6° (±8,4), pronation of 81,7° (±6,3) and supination of 84,5° (±5,5), which corresponded to 96,3 %, 97,5 %, 98,1 % and 98,8 % of the range of the unaffected contralateral limb.

Strength of fist prehension in the repaired limb was 36,4 kg force (±17,5), and thumb pinch was 6,9 kg force (±2,0), which corresponded 92,5 % and 100% of the values in the contralateral normal limb, respectively.

Using Broberg and Morrey's criteria to rate the overall functional outcome, 15 patients (36,6 %) were felt to have had a good outcome, and 26 (63,4 %) an excellent outcome. No sign of elbow instability was detected on physical examination.

DISCUSSION

The age range of the patients in this study was consistent with the literature, in that there was a majority of young adults. There also was a statistically-significant predominance of males, as reported elsewhere[9]. In this study we verified 1 case (2,4 %) of concomitant bilateral radial head fractures, which also is consistent with the roughly 2 % reported[1].

Although good results have been experienced with excision of the radial head in several previously-published studies, especially for comminuted fractures there are certain disadvantages. Among the long-term complications are pain and instability of the wrist, forearm and elbow due to proximal radial migration and cubitus valgus[8, 10–12]. Additionally, weakness of the affected extremity and long-term post-traumatic osteoarthritis have been detected[8, 10–12]. To prevent these problems, some investigators have sought to reconstruct the head of a fractured radius or replace it with a prosthesis when open reduction and internal fixation fail; in other words, when the surgeon lacks confidence in the restoration of early movement[13–18]. Ikeda et al[19] compared the clinical results of radial head resection versus open reduction and internal fixation in patients with Mason III fractures. They identified enhanced functional outcomes and strength when the radial head was reconstructed. In spite of the problems that are known to be associated with open reduction and internal fixation, like pseudo-arthrosis, secondary loss of reduction, and radial head avascular necrosis, few studies have compared the level of stability obtained with different forms of osteosynthesis.

Internal fixation can be accomplished using a variety of materials, like Kirschner wires, mini-plates, plate-sheets, mini-fragment screws, and cannulated headless screws. Patterson et al[20] compared 2 mm versus 2,7 mm plates and plate-sheets in a biomechanics study in cadavers. They assessed fractures of the radial neck and tested only axial loads, ultimately determining that the 2,7 mm plates are more resistant than those that are 2 mm, and that plate-sheets of either size are the most resistant, though this last finding failed to achieve statistical significance. Giffin et al[21] compared 2,7 mm plates, plate-sheets, and 3,0 mm crossed screws with respect to shear forces, and found that the 2,7 mm plate-sheets and crossed screws were more resistant than the 2,7 mm plates. Ikeda et al used T plates and achieved consolidation in all their patients without any problems pertaining to the materials used. This study corroborates the use of this technique. Ring et al[22] used 2,0 mm plates, 2,0 mm screws, and Kirchner wires in 56 patients with Mason II and III fractures, in whom 7 implant flaws due to lack of consolidation were identified. Pearce and Gallannaugh[23] studied 19 patients treated with open reduction and internal fixation using self-compressing screws and obtained good to excellent results. In this study, we observed consolidation in all cases without flaws in the implant, consistent with the afore-mentioned literature.

Cannulated headless screws offer distinct advantages relative to plates, in that they require less dissection, leading to less de-vascularization of the proximal radius, a lower risk of injury to the interosseous nerve, and less impact upon the annular ligament[23, 24]. This technique also abolishes safety concerns relating to the placement of synthesis material, as well as to the retreatment of materials after fracture consolidation. This translates into more

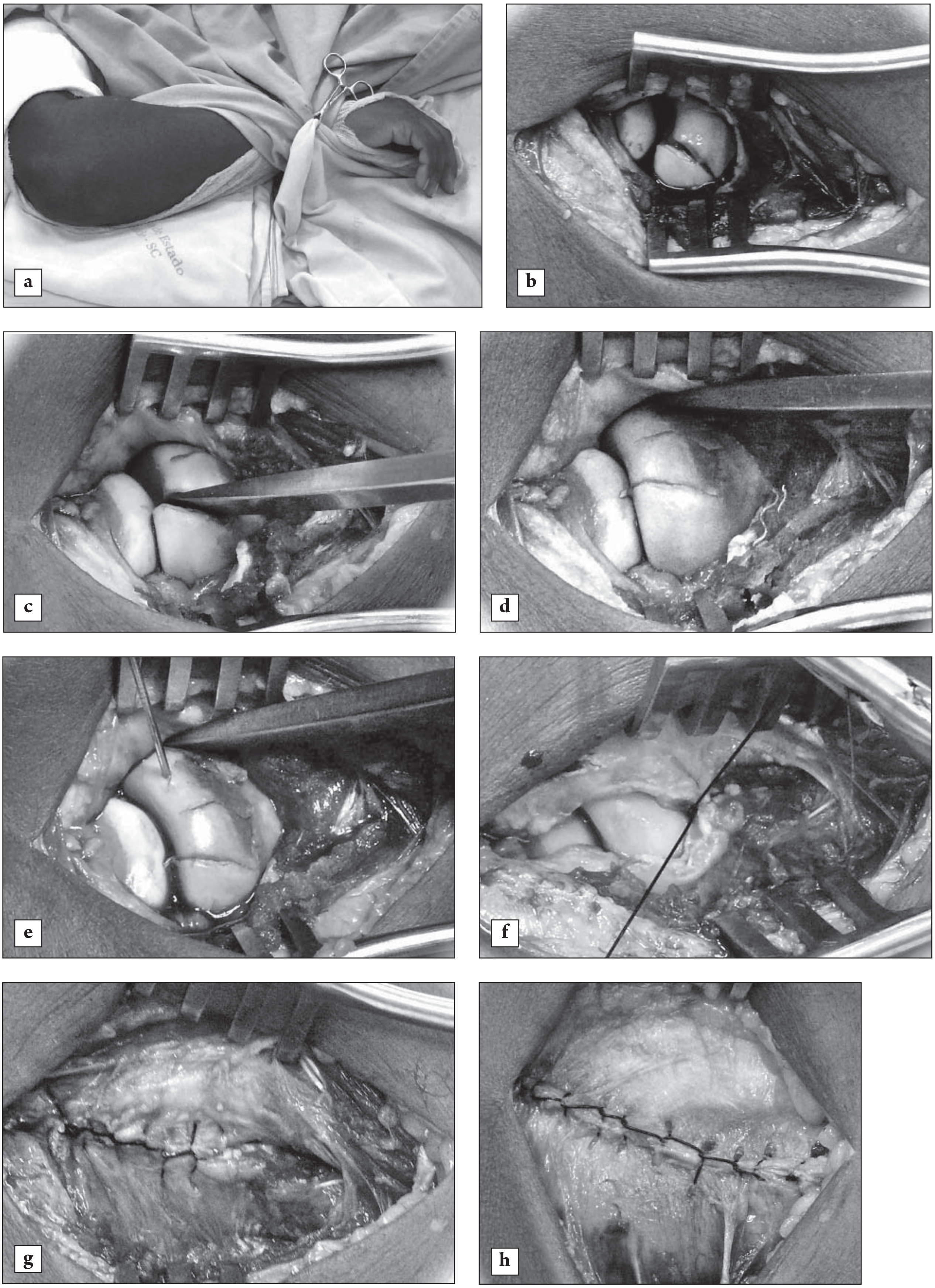

Figure 3. Surgical technique: a — positioning of the upper limb on the auxiliary table with the forearm pronated; b — opening the annular ligament and identifying the fracture; c — reduction of the fracture; d — fixation with Kirschner wires; e — placement of a cannulated headless screw; f — closing the annular ligament; g — a sutured annular ligament; h — the sutured muscular interval

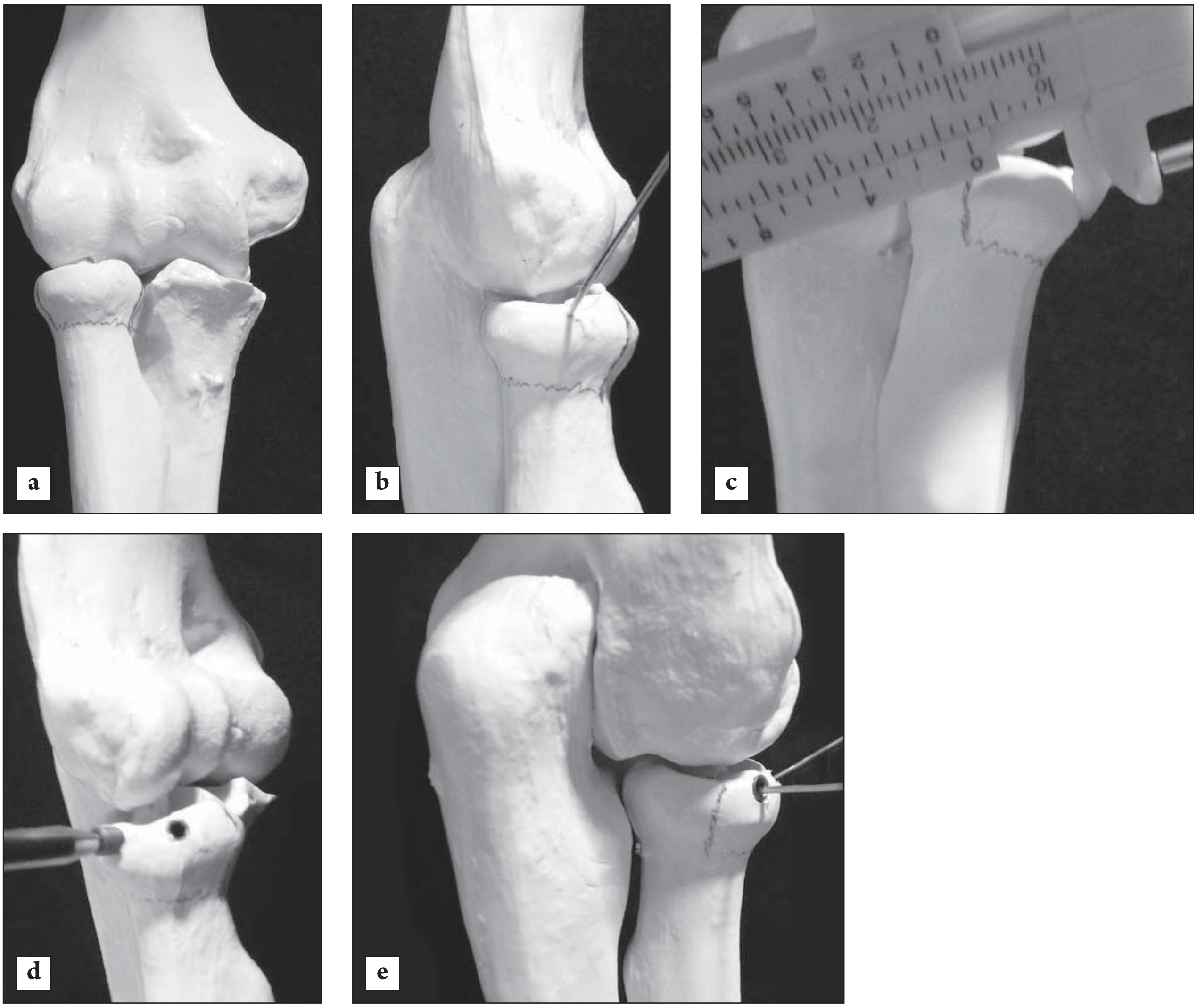

Figure 4. Summary of fracture fixation: a — fragment of the head of the anterolateral radius; b — supination of the forearm to expose the head fragment via Kocher's approach; c — measurement from the base of the drill to the bone, the measure reduced by 30 mm (the total true length of the drill bit), that difference being the size of the screw; d — introduction of the cannulated headless screw; e — position of the fastened fragment of the head of the radius; f — position of the first screw, as it fastens the head fragment at an angle of 10–15 degrees to avoid concavity of the radial head; the second screw fastens with the neck and enters at an angle between 30 and 45 degrees

rapid recovery of range of motion, as well as an earlier return to daily activities and work.

Ring et al[22] argued for open reduction and fixation of fractures with fewer than three fragments, an argument that is supported by our own data, in that we achieved fixation with consolidation of all Mason II fractures. Fractures involving the proximal radius can develop pseudoarthrosis, which may be asymptomatic and, hence, ignored[8]. As for malunion, we observed its occurrence in 6 of 11 cases in one series[25]; in 8 of 26 cases in a second[22]; and in 2 of the 42 cases described in this report.

Sanders and French[26] described their results with internal fixation in 8 patients with comminuted fractures of the radial head; and, after 12 months of follow-up, they concluded that fixation for comminuted fractures is advisable. Özkan[27] et al studied 15 patients with open reduction and internal fixation, among whom 3 had Mason II, 8 Mason III and 4 Mason IV fractures; after an average of 32 months follow-up, 12 patients were deemed to have had an excellent or good result, 1 moderate, and 2 a poor result. In our study, 15 outcomes were considered good and 26 excellent. We believe that the difference between our study and others primarily stems (a) from our exclusion of patients with other fractures or ligamentous injuries of the elbow; and (b) from our exclusion of Mason III and IV fractures.

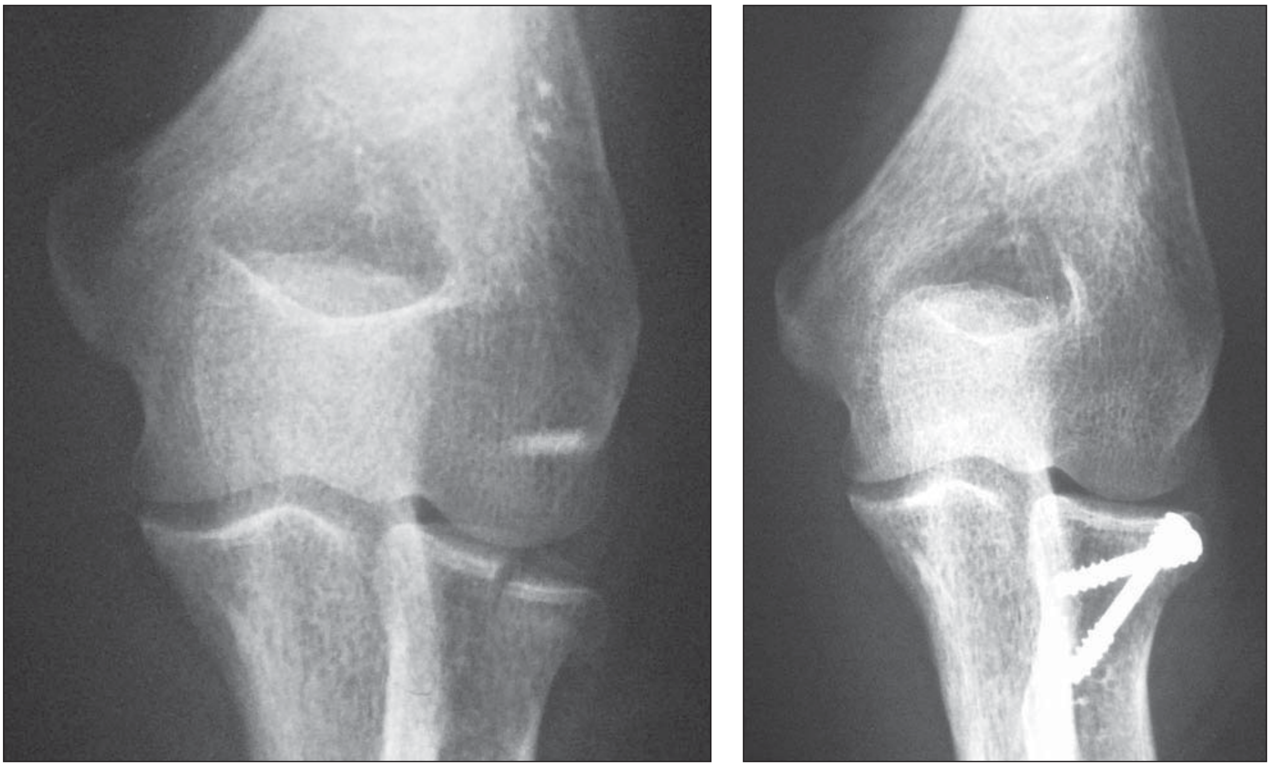

Figure 5. The affected limb of a study case (a) pre-operatively; and (b) post-operatively

One important complication and source of incapacity is any significant limitation in range of motion, with the largest losses tending to occur with higher degree fractures[24]. Our patients achieved ranges of movement that were similar to those in their contralateral, normal limb; and they experienced a good return of prehensile strength.

In the literature, there is considerable variability in the duration of time between the initial injury and the repair of radial head fractures[19, 28]. Edwards and Jupiter[28] studied 7 patients with displaced radial head fractures, operating on 3 of these within 1 week; they concluded that is better to operate earlier rather than later. Ikeda et al[19] performed fixations in 10 patients with injuries sustained an average of 10 days previously (range = 7–16) and their results were not unsatisfactory. Geel and Palmer[29] treated 19 patients with open reduction and internal fixation, in whom there were 14 excellent and 5 poor results; like Edwards and Jupiter, they recommended early reduction of displaced fractures, and in those in whom the head of the radius is angulated. Özkan et al[27] operated upon 12 patients within the first week and had good to excellent results in all instances. In our study, the average time interval between the initial trauma and reparative surgery was 9,5 days; and we too obtained good to excellent results in all. Upon closer inspection, most of our excellent outcomes occurred in patients who had their surgeries within the first week post-injury.

CONCLUSIONS

Fixation with cannulated hedless screws is an appropriate approach to the surgical repair of Mason II radial head fractures. This technique is minimally invasive, allows for a rapid return to daily activities and work, and generally yields good functional recovery.

REFERENCES

1. Pike JM, Athwal GS, Faber KJ, Graham J, King W. Radial Head Fractures - An Update. J Hand Surg 2009; 34 A: 557–565.
2. Shepard MF, Markolf KL, Dunbar AM. Effects of radial head excision and distal radial shortening on load-sharing in cadaver forearms. J Bone Joint Surg [Am] 2001; 83-A: 92–100.
3. Hotchkiss RN, Weiland AJ. Valgus stability of the elbow. J Orthop Res 1987; 15: 327—33.
4. Ikeda M, Yamashina Y, Kamimoto M, Oka Y. Open reduction and internal fixation of comminuted fractures of the radial head using low-profile mini-plates. J bone Joint Surg. 2003; 85B: 1040-4.

5. Giffin JR, King GJ, Patterson SD, Johnson JA. Internal fixation of radial head fractures: an in vitro biomechanical analysis. Clin Biomech. 2004; 19: 358-61.

6. Johnston GW. A follow-up of one hundred cases of fracture of the head of the radius with a review of the literature. Ulster Med J.1962; 31: 51–56.

7. Strachan JH, Ellis BW. Vulnerability of posterior interosseous nerve during radial head resection. J. Bone Joint Surg. 1971; 53B: 320.

8. Broberg MA, Morrey BF. Results of delayed excision of the radial head after fracture. J Bone Joint Surg [Am]1986; 68: 669-74.

9. Ring D. Displaced, unstable fractures of the radial head: Fixation vs. replacement––What is the evidence?. Injury. 2008; 39: 1329—1337.

10. Coleman DA, Blair WF, Shurr D. Resection of the radial head for fracture of the radial head. Long-term follow-up of seventeen cases. J Bone Joint Surg [Am] 1987; 69: 385-92.

11. Fuchs S, Chylarecki C. Do functional deficits result from radial head resection? J Shoulder Elbow Surg 1999; 8: 247-51.

12. Ikeda M, Oka Y. Function after early radial head resection for fracture: a retrospective evaluation of 15 patients followed for 3-18 years. Acta Orthop Scand 2000; 71: 191-4.

13. Esser RD, Davis S, Taavao T. Fractures of the radial head treated by internal fixation: late results in 26 cases. J Orthop Trauma 1995; 9: 318-23.

14. Ikeda M, Sugiyama K, Kang C, Takagaki T, Oka Y. Comminuted fractures of the radial head. Comparison of resection and internal fixation. J Bone Joint Surg [Am] 2005; 87: 76-84.

15. King GJ, Evans DC, Kellam JF. Open reduction and internal fixation of radial head fractures. J Orthop Trauma 1991; 5: 21-8.

16. McArthur RA. Herbert screw fixation of fracture of the head of the radius. Clin Orthop Relat Res 1987; (224): 79-87.

17. Bain GI, Ashwood N, Baird R, Unni R. Management of Mason type-III radial head fractures with a titanium prosthesis, ligament repair, and early mobilization. Surgical technique. J Bone Joint Surg [Am] 2005; 87 Suppl 1(Pt 1): 136- 47.

18. Pribyl CR, Kester MA, Cook SD, Edmunds JO, Brunet ME. The effect of the radial head and prosthetic radial head replacement on resisting valgus stress at the elbow. Orthopedics 1986; 9: 723-6.

19. Ikeda M, Sugiyama K, Kang C, Takagaki T, Oka Y. Comminuted fractures of the radial head: Comparison of resection and internal fixation. Surgical technique. J Bone Joint Surg 2006; 88A Suppl 1 (Pt 1): 11–23.

20. Patterson JD, Jones CK, Glisson RR, Caputo AE, Goetz TJ, Goldner RD. Stiffness of simulated radial neck fractures fixed with 4 different devices. J Shoulder Elbow Surg 2001; 10: 57– 61.

21. Giffin JR, King GJ, Patterson SD, Johnson JA. Internal fixation of radial neck fractures: An in vitro biomechanical analysis. Clin Biomech (Bristol, Avon) 2004; 19: 358 –361.

22. Ring D, Quintero J, Jupiter J. Open reduction and internal fixation of fractures of the radial head. J Bone Joint Surg Am. 2002; 84: 1811-15.

23. Pearce MS, Gallannaugh SC. Mason type II radial head fractures fixed with Herbert bone screws. J R Soc Med. 1996 Jun; 89(6): 340P-4P.

24. Hartman MW, Steinmann SP. The radial head fractures. In: Celli A, Celli L, Morrey BF. Treatment of elbow lesions. Milan: Springer; 2008. p. 83-8.

25. Heim U. Surgical treatment of radial head fracture. Z Unfallchir Versicherungs-med.1992; 85: 3—11.

26. Sanders RA, French HG. Open reduction and internal fixation of comminuted radial head fractures. Am J Sports Med. 1986; 14: 130-5.

27. Özkan Y, Öztürk A, Özdem RM, Aykut S, Yalçin N. Open reduction and internal fixation of radial head fractures. Turkish Journal of Trauma & Emergency Surgery. 2009; 15(3): 249-255.

28. Edwards GS Jr, Jupiter JB. Radial head fractures with acute distal radioulnar dislocation. Essex-Lopresti revisited. Clin Orthop Relat Res 1988; (234): 61-9.

29. Geel CW, Palmer AK. Radial head fractures and their effect on the distal radioulnar joint. A rationale for treatment. Clin Orthop Relat Res 1992; (275): 79-84.

Поступила в редакцию 23.03.2011
Утверждена к печати 1.06.2011

Authors:

Cristiano Paulo Tacca — MD.
Jan Richard Rost — MD, MSc.
Jayme Augusto Bertelli — MD, PhD.
Priscila Myashita — Therapist.

Contacts:

Cristiano Paulo Tacca
Rua Almirante Barroso, 45, Block Jade, Capable 702, Bairro João Paulo, Florianópolis, SC, 88030460
Fax: 55-48-32294000; Telephone: 55-48-32335569
Email: cristianotacca@yahoo.com.br