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Short term comparative study of radial head fracture treated with radial head platting and radial head excision

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Abstract
Introduction: The elbow is the joint between your upper arm and your forearm. It is made of several joints. One of these is called the radial-capatellar joint. The disc-shaped radial head moves and rotates against a round part of the humerus called the capitellum. As your radial head moves against the capitellum, it allows you to turn your palm up (supination) and down (pronation), as well as allowing you to bend and straighten your elbow. The elbow allows you to move your hand in space and put it where you want it. The radial head is the key to this motion.
Aims and Objectives: The aim of our study to compare the functional outcome in operative modalities in radial head fracture like radial head platting, excision in terms of range of movement, functional outcome, return to normal previous work.
Materials and Methods: After institutional board approval and informed consent from patients, this prospective case controlled clinical study as carried out in 30 patient, with ASA physical status 1 and 2. All patients had anterior –posterior and lateral radiographs of elbow.
The patients will be assessed preoperatively in form of range of movements, pain, stability.11 cases operated for radial head platting and 19 cases operated for radial head excision and assessed at follow up visits for range of movements, return to work and graded according to mayo's elbow score.
Results: Among 30 patient, according to mayo's elbow score results are excellent in 18.18%, good in 45.45%, fair in 36.36% in patients treated with radial head platting and excellent in 36.84%, good in 63.15% patients treated with radial head excision. Average trauma and surgery interval was 3 to 5 days. The duration of hospital stay post operatively was less in radial head excision 2 to 3 days and 5 to 7 days for radial head platting. The mean time for union in radial head platting is 8 to 10 weeks except one patient had delayed union and it took 12 week until osseous union was evident radiographically.
The average time for return to normal work was 11 weeks in radial head excision and 13 weeks in radial head platting.
Conclusion: Radial head excision offers the following advantages when compared with radial head platting. a) better stability b) full strength c) good functional outcome. In our study, the rehabilitation time was much shorter for fractures operated with excision when compared with ORIF. Excision provides for short operating time, short hospital stay and early rehabilitation than ORIF. While ORIF have better functional outcome and less complication. If adequate fixation done in ORIF excels better results.

Keywords: Radial head fractures, excision, open reduction internal fixation

Introduction
The elbow is the joint between your upper arm and your forearm. It is made of several joints. One of these is called the radial-capatellar joint. The disc-shaped radial head moves and rotates against a round part of the humerus called the capitellum. As your radial head moves against the capitellum, it allows you to turn your palm up (supination) and down (pronation), as well as allowing you to bend and straighten your elbow. The elbow allows you to move your hand in space and put it where you want it. The radial head is the key to this motion.
The elbow joint is surrounded by a thick capsule. There are lots of ligaments (tissues that connect bone to bone) that make the elbow stable and not "floppy." Lots of muscles are attached to the bone on both sides of the elbow joint, but the thickest parts of the muscles aren't at the elbow itself.

That's why when you touch your elbow you can feel the bones easily under the skin. That also means it can be easy to break the elbow, because there isn't much padding.

There are also nerves and blood vessels that cross the elbow. These are located mostly in the front of the elbow and on the inside. The ulnar nerve is located on the inside of the elbow close to the bone. When you hit this nerve, it is very painful and is commonly called hitting your "funny bone."

Most radial head fractures are treated without surgery. This requires the pieces to be lined up well and for there to be good motion at the elbow. Non-operative treatment usually means a short period of rest in a sling followed by gentle motion. Lifting, pushing and pulling more than a few pounds with the injured arm is limited for 6-12 weeks. Depending on your pain level, you may be able to get back to light activities such as typing early in the healing process. Your physician will typically get x-rays when you follow up with them to make sure that the break is healing or at least has not moved. You may be given a prescription for physical therapy to help regain motion.

If your bones are not lined up or the broken piece(s) block motion of your elbow joint, and/or if your bone is in multiple pieces, you may need surgery. This is done with a cut or incision on the outside of the elbow. In general, if the bones can be repaired they are fixed with screws, plate and screws, or very small wires. Your surgeon will make sure your bones line up well, and that the plates and screws don't limit your elbow motion. If the radial head is broken into many small pieces, it may not be fixable. In those cases, a radial head replacement may be used. This is where the radial head fragments are removed, and a metal replacement is placed to substitute for the part of the bone that was removed.

A splint or brace may be used after surgery to limit motion. Pushing, pulling, and lifting more than 5 pounds is limited for 6-12 weeks to allow the bone and wound to heal. Your surgeon may recommend physical therapy to help prevent elbow stiffness. You will likely see your surgeon several times after your injury to make sure you are healing well.

Aim of the study

To evalute the result of different operative procedure in radial head fracture based on mayo elbow performance index score.

Assessment of elbow function and functional abilities of patient in follow up studies.

Operative procedure such as radial head excision radial head platting.

Materials and Methods

This is a prospective study of 30 cases of radial head fractures of elbow in adults treated by surgical fixation and excision.

It includes all comminuted and simple of radial head in adults. Comminuted, simple fractures are included in this study. All compound fractures, malunited fractures, and complicated fracture and fractures in children are excluded from this study.

Inclusion Criteria

1. radial head and neck fractures of elbow in adults >18 years
2. Comminuted and displaced fractures

Exclusion Criteria

1. Compound fractures
2. Malunited fractures
3. complicated fracture

The cases were analysed as per the following criteria

1) Age distribution
2) Sex distribution
3) Side of injur
4) Mode of injury
5) Classification of fracture
6) Time interval between injury and surgery
7) Associated injures
8) Complications
9) Additional procedures for complications
10) Duration between injury and hospitalization
11) Mayo's elbow score

Procedure and post operative protocol

All the patients were received in the casualty department and were resuscitated. If there were any other major associated injuries, they were treated accordingly at first. After the general condition of the patient improved, radiographs (AP View and lateral view)of elbow were taken. The fractures were reduced in closed manner at first under sedation and an above elbow slab was applied. Fractures with comminution were taken for excision of radial head. Other simple cases were fixed with plates.

Open reduction and internal fixation with radial head plates

We routinely used tourniquet during surgery. The radial head exposed from lateral side of elbow. We always used kocher's approach for exposing the radial head. The cleavage between anconeus and extensor carpi ulnaris was developed. The LCL was retracted medially along with ECU. Incise the annular ligament in the midlateral plane to avoid injury to lateral ulnar collateral ligament (LUCL). It is better to do a Z capsulotomy for better repair after plate fixation or arthroplasty.

The fractured site identified and with minimal periosteal stripping, they were mobilized. The medullary cavity was cleared of any hematoma and the fractured fragments were reduced by carefully matching the interdigitations using bone holding forceps. A radial head plate of appropriate length was selected and applied to the radial head on the lateral side and fixed with 2.7mm locking cortical screws. All the fractures were fixed such that there were at least six cortical purchases on either side of the bony fragment. Thorough wash of both wounds done. The LCL and annular ligament are repaired after that subcutaneus and skin closure was done. Compression bandage was applied. Tourniquet was released and an above elbow slab was applied.

Post operative protocol

In the immediate post operative period the upper limb was immobilized in an above elbow slab, and kept elevated till the edema of fingers subsided. The wound was inspected on the II POD and then suture removal was done on Xth POD. The upper limb was immobilized depending upon the rigidity of fixation. At the end of 4th and 6th weeks check X rays were taken to visualize callus response. The pronation and supination movements were started by the end of 6th week.

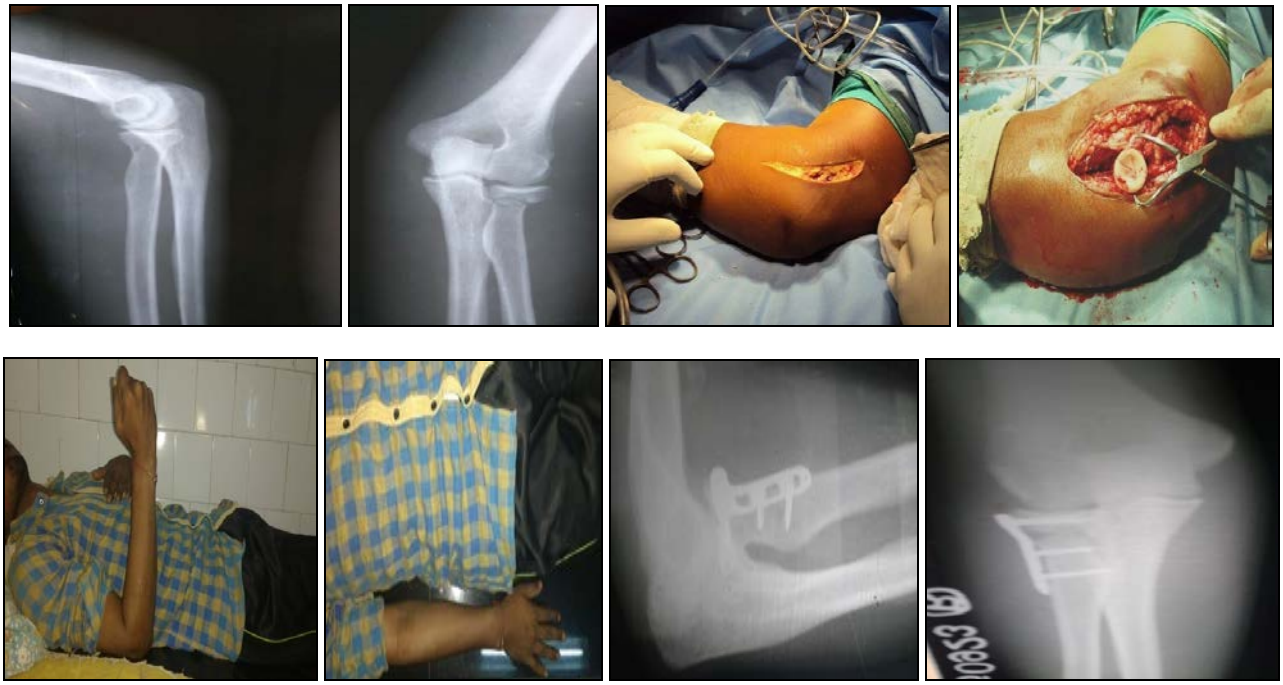

Fig 1: Radial head platting with preoperative, intraoperative and follow up images

Radial head excision

Most of the comminuted fractures which could not be fixed adequetely were excised.

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Post operative protocol

The upper limb was kept elevated. Wound inspection was done on II POD. Suture removal was done on X^{th} POD, and above elbow slab was applied. After 3 weeks the slab was removed, after obtaining check X rays. Active elbow mobilization exercises were started at the end of 3rd week. By the end of 6 weeks, the cast was discontinued and active pronation and supination exercises were started.

Fig 2: Radial head excision preoperative images, intraoperative image, follow up range of motion

Result

Average time of fracture healing was 8 weeks. In patients who had undergone radial head platting, it was 8 weeks. Most fracture patterns healed between 8 and 10 weeks. All fractures showed osseous union. One patient had a delayed union, and it took 12 week until osseous union was evident radiographically.

Six patients had restricted pronation & supination five patients were treated with radia lhead platting and one patient with radial head excision had restricted supination and pronation. Seven patients treated with excision gave excellent results with regard to pronation & supination. The mean pronation was 84°, and the mean supination was 85°. Restoration of pronation & supination activities were possible by the end of 6th week using excision whereas they were possible by the end of 9th week using ORIF.

Six patients developed post-operative stiffness of elbow joint. Four patients were treated with ORIF and two patient with radial head excision. However, all these patients eventually had fair range of motion by the end of 12 weeks following intense physiotherapy.

Almost all people treated with both dual plating and hybrid fixation could resume their own normal activities and could continue their previous work successfully. Restoration of normal activities were possible at the end of 12-14 weeks in patients treated with radial head platting but in case of radial head excision it was around 10-11weeks.

Twenty-one patients (81%) had no elbow pain, five had mild pain, and four had moderate pain. The mean arc of motion was from 9° to 139° of flexion.

The mean Mayo Elbow Performance Score was 95 points; the score was classified as good or excellent for twenty six elbows (87%) and as fair for four.

Three patients complained of wrist pain, which was mild in two patients and moderate in one. Nineteen elbows had normal strength in comparison with the unaffected side.

In two patients, some degree of elbow instability could be detected on physical examination. The mean carrying angle of the involved elbow was significantly greater than that of the uninjured elbow (21° compared with 10°).

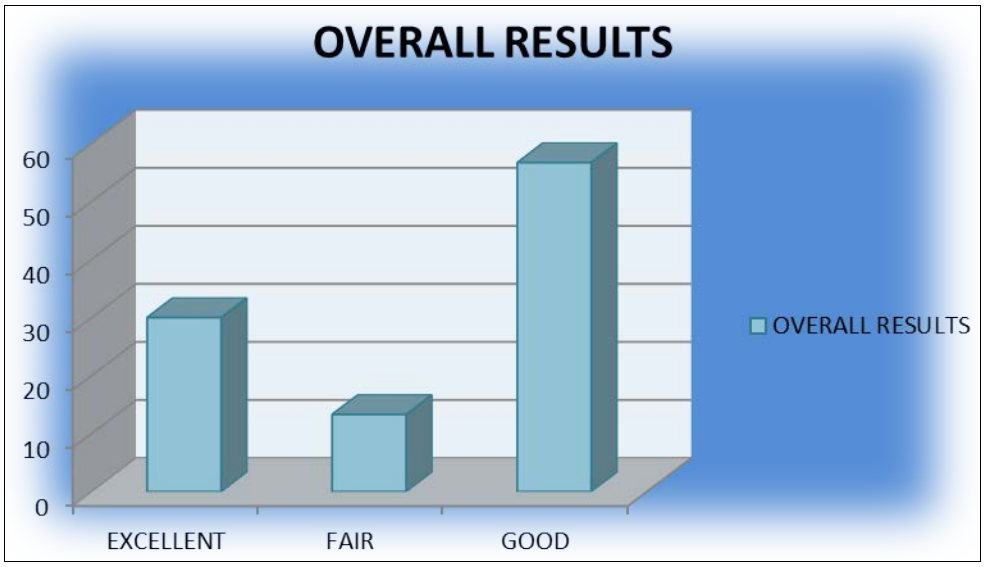
One patient required antibiotics for a superficial wound infection in the immediate postoperative period. There were no deep infections. Occasional pain and/or paresthesia as were present in two patients; however, these symptoms decreased with time, and, at the time of the final follow-up, they did not require treatment for this problem.

The Analysis was done using modified Mayo's Elbow Score Index and the following results were obtained.

Overall Results

Table 1: Overall Results

Grading	Number of Cases	Percentage
Excellent	9	30.0
Fair	4	13.3
Good	17	56.7
Total	30	100.0

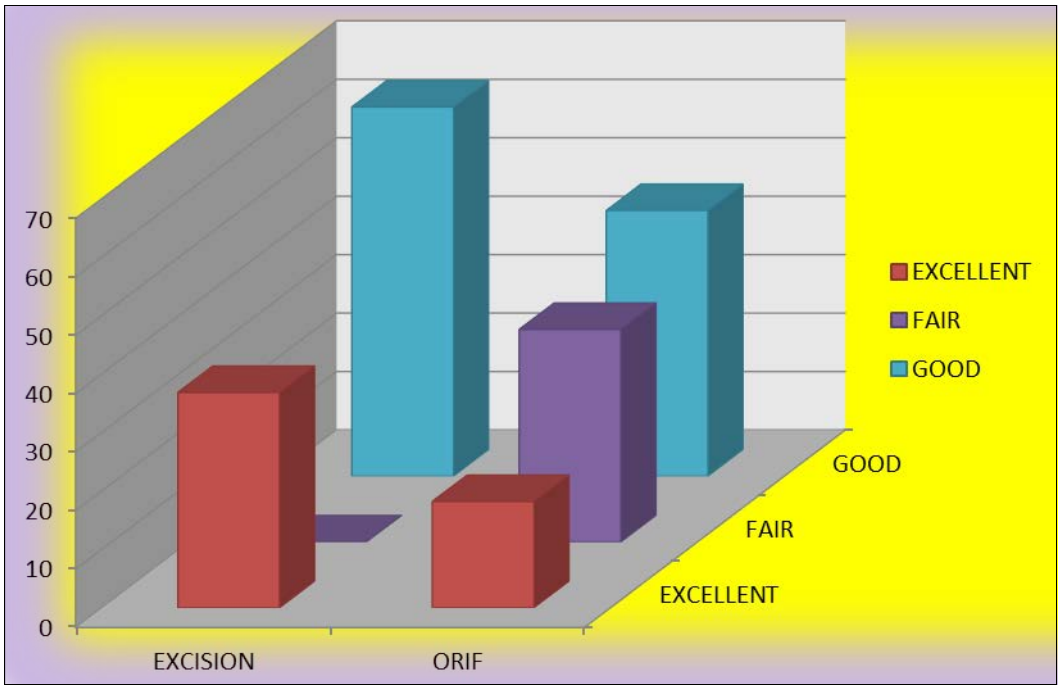


Graph 1: Overall Results

Results according to procedure

Table 2: Results according to different procedure

Implant	Number of cases	Grading	Percentage
ORIF	2	Excellent	18.18%
	5	Good	45.45%
	4	Fair	36.36%
Number of cases		**Grading**	**Percentage**
Radial head excision	7	Excellent	36.84%
	12	Good	63.15%
	0	Fair	0%



Graph 2: Results according to different procedure

Statistical Analysis

The mean value of MAYO'S ELBOW SCORE INDEX in Patients who underwent EXCISION is 8.103 and in dual plating is 9.298. Standard deviation being 2.17 and 2.15 for patients who underwent hybrid fixation and dual plating respectively.

The P value was found to be 0.0013 hence the study supports that excision is superior to ORIF.

Discussion

The aim of this study is to know the results of treating radial head fractures of elbow with operative modalities mainly radial head excision and radial head platting.

Radial head fractures are among the most common fractures occurring around the elbow in adults, accounting for 1.5% to 4% of all fractures and approximately 33% of all elbow fractures. Although radial head fractures can occur in isolation, associated fractures and ligament injuries are common. Assembling the clinical presentation, physical examination, and imaging into an effective treatment plan can be challenging. The characteristics of the radial head fracture influence the technique used to optimize the outcome.

The mechanism of injury in radial head and neck fractures is usually a fall onto an outstretched hand with a partly flexed elbow and pronated forearm, causing a longitudinal impact of the radius against the capitellum. The force of trauma is transmitted along the forearm, producing a valgus stress at the elbow and causing compression of the radial head against the capitellum, which results in fracture due to shear between the vertically aligned trabeculae and may injure the capitellum. Clinically, moderate to severe pain, local tenderness with swelling, and a positive fat pad sign with a fracture line on radiography are diagnostic features. Conventional radiography with anteroposterior and lateral views is usually adequate for detection of radial head and neck fractures. Internal and external oblique radiographs are occasionally required. Computed tomography with reconstruction images is helpful to aid in decision making.

Mason's classification, based on the severity of radial head and neck fracture, is used clinically to formulate the type and extent of treatment. Mason classified radial head fractures into 3 groups: type I is an undisplaced marginal fracture, type II is a displaced marginal fracture, and type III is a comminuted fracture. A fourth group was subsequently added: type IV, which includes any radial head fracture with dislocation of the humeroulnar joint.

We selected 30 cases of radial head fractures in the elbow in adults. Most of these patients fell into middle age, group with majority of them being males. The mode of violence is either due to RTA or due to accidental fall. The patients who had simple mason type 2 fracture pattern were fixed with plate and the fractures with comminution were undergone radial head resection. Compound fractures were excluded from our study.

Radial head fracture classically has been classified according to the radiographic appearance. These classifications failed to take into account associated ligamentous injuries to the elbow. These early classification were found by Carstam, Bakalim and Mason. Johnston added a fourth category to Mason's classification in that he identified fractures associated with elbow dislocation. At the present time, the commonly used classification for radial head fractures is the Modified Mason Classification.

The Modified Mason Classification1 can be used as a guide to decide on the most appropriate treatment for each type of fracture. This classification also used for radial neck fracture.

In Type I, there is marginal fracture which is undisplaced or with minimal displacement. Intra-articular displacement is less than 2mm. In this group, non-operative treatment with arm sling and early mobilization as tolerated with or without aspiration of joint for pain relief gives a good outcome. Even if the fracture is associated with elbow dislocation, the treatment is the same as above.

In type II, there is marginal fracture with displacement more than 2mm. If there is mechanical block in elbow range of motion, then open reduction with internal fixation is recommended. Without mechanical block, type II can be treated as for type I. With associated elbow dislocation or interosseous ligamental tear (Essex-Lopresti), open reduction and internal fixation using screw or plate is recommended.

In type III, there is comminuted fracture of the radial head or completely displaced fracture of the radial neck. If there is no

concomitant elbow dislocation or interosseous ligament disruption, early excision of the radial head is an option. But if there is associated interosseous ligament disruption, excision and insertion of radial head prosthesis is recommended.

The comminution is usually greater than expected from the preoperative radiographs, so approximately 70% would have a definitive fixation of the fracture as intended and the remainder would require radial head excision with or without radial replacement. The lack of soft tissue attachment to the radial head fragments intra-operatively would be against routine fixation because of concern about avascular necrosis and non-union.

In this patient radial head excision was chosen because he has no other associated soft tissue injury. However he may still develop complications associated with radial head excision such as loss of grip strength, wrist pain, valgus instability, heterotrophic ossification and post-traumatic arthritis of the trochlea-olecranon articulation. Another complication which has not been recognized previously as a complication of radial head resection is postero-lateral rotatory instability. This complication is difficult to diagnose due to the absence of the radial head after radial head excision. Hall and McKee2 have identified a series of patients with postero-lateral rotatory instability following radial head resection. They believe that this instability is secondary to unrecognized lateral ulna collateral ligament deficiency pre-operatively and this instability may be a cause of unexplained elbow pain and instability following radial head excision.

The reported long term outcomes of the treatment of radial head and neck fractures with excision of the radial head excision have been mixed. Herbertson4 and colleagues has shown that following a displaced radial head or neck fracture, excision of the radial head often leads to a good or fair result. They also found no differences in outcome between primary and delayed radial head excisions following a Mason type II or III fracture. The outcomes are associated with the type of fracture, with Mason type III fractures having the worst results, rather than with the timing of the radial head excision.

The other available option to avoid these complications especially in a young patient population is replacement of the radial head with prosthesis.

In the elderly patient, low energy injury or lack of associated soft tissue disruption, resection of the radial head alone is an acceptable approach and in most instances is not associated with long term sequelae. This has been shown by Janssen and Vegter1, where more than half of the patients had radiographic evidence of proximal migration of radius from 1 to 3mm after radial head excision, but only a few had any or mild wrist symptoms.

This case illustrates that excision of the radial head is an acceptable option and often leads to a good or fair result if used in the right situation. It also stressed the importance of assessing other associated soft tissue injuries with radial head fracture as it will affect the choice of treatment for individual patient and the long term outcome. Although Modified Mason classification does not include associated soft tissue injuries, it is still useful to guide the surgeon for the most appropriate treatment for each type of fracture.

A satisfactory device for internal fixation must hold the fracture rigidly, eliminating as completely as possible angular and rotatory motion. This can be accomplished by radial head plates.

During radial head platting, to minimize further injury to blood supply of the bone, the periosteum was stripped sparingly with a periosteal elevator and only sufficiently for applying a plate. The fragments were carefully reduced with interdigitating bone spicules being fitted properly. Comminuted fragments were fitted accurately in place. The plates were selected such that at least there were four to six cortical purchases on either side of fracture fragments. The plates were contoured before they were applied to the bone. Our study has showed good fracture union occurred in 80% of cases.

We compared the results of ORIF with that of excision. Apart from the incidence of infection we did not have complications. We used tourniquet in fractures fixed with ORIF. One case of tourniquet palsy occurred but recovered eventually. Since tourniquet was used for less time in excision, the chance for occurrence of this neurological complication was minimal.

ORIF offers the following advantages when compared with dual plate osteosynthesis. a) better stability b) full strength c) good functional outcome

In our study, the rehabilitation time was much shorter for fractures operated with excision when compared with ORIF. The average time required for functional recovery is more than 9 weeks in ORIF, and about 6 weeks when excision. The duration of hospital stay post operatively was also less (on an average of 3 days for excision and 5 days for ORIF).

Excision provides for short operating time, short hospital stay and early rehabilitation than ORIF. While ORIF have poor functional outcome and more complication. Excision is better than ORIF.

Conclusion

It is functional rating score or degree of functional recovery that really makes a difference.

In our study, we found the functional rating score of excision was higher than that of the ORIF. The reason we thought was that excision had a better recovery of physiological and physical function.

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