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A Historical Perspective on the Essex-Lopresti Injury

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Abstract

An Essex-Lopresti injury is a fracture of the radial head with concomitant dislocation of the distal radioulnar joint and rupture of the interosseous membrane. Poor outcomes have been associated with this rare injury if the dislocation of the distal radioulnar joint is missed in the acute setting. This injury is named after the British orthopedic surgeon Peter Essex-Lopresti, who made a number of important observations about this injury in 1951. Peter Essex-Lopresti was a promising young surgeon, and his untimely death at the age of 35 brought an early end to a remarkable career. This article investigates the evolution of treatment for this injury and sheds light on the life of the surgeon for whom the injury is named.

Keywords

Distal radio-ulnar joint; Essex-Lopresti fracture; Radial head fracture

The Essex-Lopresti injury is characterized by a fracture of the radial head with concomitant disruption of the distal radioulnar joint (DRUJ) and rupture of the interosseous membrane (IOM). (Figure 1) These injuries are often caused by high-energy impacts involving a longitudinal force acting on the forearm, such as vehicular trauma or a fall from a height.(1) Essex-Lopresti injuries are rare and account for approximately 1% of all radial head fractures.(2) Nevertheless, understanding these injuries is important because the DRUJ and IOM injuries are often missed in the acute setting. Failure to diagnose these injuries often leads to debilitating chronic problems including wrist pain, wrist subluxation, and proximal migration of the radius. These problems are worsened if the radial head is resected, because the other structures stabilizing the radius (the IOM and DRUJ) are damaged. This leaves the radius free to migrate further proximally when the radial head is removed. Despite descriptions in the literature of this injury's unique features, the evolution of treatment of this injury has been incompletely reported. Therefore, we investigated the reports of authors

who made important contributions to the development of treatment for this injury. We also researched the life of Peter Essex-Lopresti, the British trauma surgeon for whom the injury is named. Our study for this project involved a comprehensive literature search regarding the treatment of the injury and historical research from the Royal College of Surgeons of Edinburgh, World War II memoirs, and correspondence with Michael Essex-Lopresti, Peter's younger brother.

Peter Gordon Essex-Lopresti (1915–1951)

Peter Essex-Lopresti (Figure 2) was born in London on April 7, 1915. His unique surname is a combination of his English grandmother's surname (Essex) and Italian grandfather's surname (Lopresti). He attended Brentwood school and completed his medical education at London (now Royal London) Hospital at Whitechapel in 1937.(3) Peter Essex-Lopresti was a brilliant pianist, and as a student sometimes took over for the cinema organist Bobby Pagan at the Troxy in nearby Commercial Road so that Pagan could catch the last train to Southend when the show ran late. He would put on a white jacket and rise up on the organ to play a series of popular melodies of the day. He started as an anesthetist in 1938, however, in January 1940 he began a series of orthopedic surgery jobs that included resident appointments at Harlow Wood Orthopedic Hospital and at the West Norfolk and King's Lynn General Hospital.(4) In July 1941, he became Registrar at the Royal Free Hospital where he met his future wife, Muriel, an obstetrician. In 1942, he was awarded his Fellowship of the Royal College of Surgeons of Edinburgh.

Essex-Lopresti joined the Royal Army Medical Corps as a surgeon in July 1943 and subsequently volunteered for the 225th (Parachute) Field Ambulance. In June 1944, he was airdropped into France a few hours before the D-Day invasion along with troops of the British 6th Airborne Division.(5) His small team of medical orderlies and soldiers captured a farmhouse which they converted into a hospital in time to deal with casualties from the first landings.(6) During the first 40 hours of the battle, the 2 surgical units of his field ambulance completed 43 operations on wounded soldiers.(5) Essex-Lopresti also helped to care for the wounded during Operation Varsity, the Rhine River crossing on March 24, 1945.

In 1946, after leaving the 225th Field Ambulance, Essex-Lopresti published an article entitled "The Hazards of Parachuting", which chronicled the parachute-related injuries he encountered during his time with the 6th Airborne.(7) This interesting report detailed injuries that occurred during the 3 phases of the jump: exiting the plane, development (opening) of the chute, and finally landing. He described methods that paratroopers could use to avoid injury. These methods included extending the neck to avoid hitting the forehead on the lip of the opening upon exit of the airplane and keeping the legs together while landing to prevent ankle injuries. The report also explained that injuries were more common among heavier parachutists and when wind speeds exceeded 15 miles per hour.

After his service with the Royal Army Medical Corps, Essex-Lopresti was appointed on April 17, 1947 as a consultant at the Birmingham Accident Hospital, one of the first medical centers dedicated solely to trauma.(8) (Figure 3) While at Birmingham Hospital, he helped

to reorganized the postgraduate program.(4) He also continued to engage in research and published articles on the open wound in trauma and fractures of the calcaneus.(9,10) He was honored with the appointment of Hunterian Professor at the Royal College of Surgeons of England. He delivered the Hunterian lecture on “The Mechanism, Reduction Technique, and Results in Fractures of Os Calcis” on March 6, 1951.(10) In May 1951, Essex-Lopresti published “Fractures of the Radial Head with Distal Radioulnar Dislocation”, the report that resulted in his name being associated with the injury.(11) Unfortunately, shortly after this article was published, on June 13, 1951 Essex-Lopresti died from a myocardial infarct at his home at the age of 35. His death put an early end to a bright and promising career. He is survived by his son Timothy and daughter Catherine.

Evolution of management of Essex-Lopresti injury

It is easier to understand the mechanics of forearm fracture dislocations (Monteggia, Galeazzi, and Essex-Lopresti) if we consider the radius, ulna, interosseous membrane (IOM), and proximal and distal radioulnar joints to form a stable ring made of 5 components. An injury involving 2 or more components makes the ring unstable. All components must be recognized and appropriately addressed to restore function.(12) The 3 components of the Essex-Lopresti injury are the radial head fracture, the dislocation of the DRUJ, and the tear of the IOM. The management of this injury has evolved over time with improvements in treatment of each of these components. This evolution can be considered in 3 chronological periods. In the early period (1930–1951), the components of the Essex-Lopresti injury were identified and the importance of preserving the radial head became apparent. In the intermediate period (1952–1990), the availability of radial head prostheses allowed good results in patients whose radial head could not be salvaged. In the current period (1991-present), with better understanding of the anatomy of the IOM and better tools to evaluate it, reconstruction has become a consideration that continues to be under investigation.

Early Period (1930–1951)

Although this injury is named after Essex-Lopresti, he was not the first to report it. Brockman published 1 possible early report of this injury pattern in 1930. Brockman reported on 2 cases of radial head fractures associated with proximal migration of the radius(13) The first case was a 42-year-old man, who fractured the head of his radius by falling on his elbow. The radial head was excised and upon follow up, subluxation of the wrist was evident. However, the patient did not have weakness or pain of the wrist, and Brockman suggested that the patient have no further treatment. The second case was a 19-year-old woman who also fractured the head of the radius. Six years prior to coming to Brockman, the woman fractured her proximal radius, and the radial head was later excised. She presented to Brockman with weakness and pain of the wrist. For this patient Brockman suggested an ulnar shortening osteotomy along with a plaster cast with the elbow in extension to correct the DRUJ. The outcome of treatment was not reported. These case reports gave detailed descriptions of radial head fractures resulting in disruption of the DRUJ. However, because the DRUJ was not examined at the time of injury, it is unclear whether the proximal movement of the radius occurred at the time of injury (indicating an

Essex-Lopresti injury). Alternatively, the proximal migration of the radius may have occurred gradually after removal of the radial head, as this sometimes occurs.

The first confirmed case of the Essex-Lopresti injury is attributed to Curr and Coe, who in 1946 reported on a patient with a radial head fracture and concomitant dislocation of the DRUJ.⁽¹⁴⁾ This injury occurred during a mining accident when the patient's forearm was caught between 2 mining hutches. The patient presented with swelling and limited movement at the elbow, forearm, and wrist. The hand was radially deviated, and radiographs showed that the DRUJ was dislocated. (Figure 4) Given the severity of the dislocation, it was concluded that the IOM must be damaged. Using traction, the surgeons were able to reduce the proximal dislocation of the radius. This treatment also corrected the proximal migration of the radius. Additional manipulation was needed to correct the position of the ulna. Subsequently the arm was immobilized for 6 weeks. One year later, the patient had good elbow and wrist movement, but pronation and supination were limited to 5 degrees in either direction.

In Essex-Lopresti's 1951 paper, he reported 2 cases.⁽¹¹⁾ In the first, a 46-year-old man was pushing hard on a loaded truck with arms extended. Suddenly the truck stopped, transferring a longitudinal compression force to the patient's forearms. This resulted in a comminuted fracture of the head of the radius. (Figure 5A) Essex-Lopresti decided to excise the radial head, which led to even more proximal migration of the radius, radial deviation of the hand, and obvious dislocation of the DRUJ. (Figures 5B, 5C) Essex-Lopresti noted that he failed to consider the impact of the proximal migration of the radius on the DRUJ. He then attempted to reduce the radius using traction, which was not successful. Although the patient regained function, he continued to have marked radial deviation of the hand resulting from proximal migration of the radius.

In the second case, a man fell off a ladder and extended his arm to catch himself, resulting in a comminuted radial head fracture. In this instance, on radiographic inspection, disruption of the DRUJ was recognized. Therefore, in light of the poor result in the first case, in which the radial head was excised, Essex-Lopresti opted to instead reconstruct the radial head by reduction and internal fixation. This avoided the need for additional surgery and corrected the dislocation at the DRUJ. One year after the operation, the patient had good motion at the elbow, and the arc of rotation was 45 degrees.

Although Essex-Lopresti's paper only reported on the treatment of 2 patients, he nevertheless made important observations about this injury. His first observation was that although the injury is uncommon, it is important to inspect the DRUJ when a radial head fracture is present. This is because failure to recognize involvement of the DRUJ can lead to more severe complications at the DRUJ that require additional surgery. Second, Essex-Lopresti recognized that for this injury, excision of the radial head should be avoided, and instead reconstruction by reduction and internal fixation should be used if possible. Third, he deduced that in the case of severe comminution, a prosthesis could be used to replace the radial head and restore longitudinal stability of the forearm. Radial head prostheses were first reported by Kellogg Speed in 1941, who replaced severely comminuted radial heads with Vitallium caps to prevent heterotopic bone formation.⁽¹⁵⁾ However, Essex-Lopresti's

observation was interesting because although these prosthetics existed, they were not commonly used.

Intermediate Period (1952–1990)

There are 3 reports of Essex-Lopresti injuries during this time period. This may be because the injury was recently described and no surgeon had a large series yet. After Essex-Lopresti, the next report was by McDougall and White in 1957.⁽¹⁶⁾ They reported on a farmer who was thrown from a motorcycle and landed on his left hand. Clinical and radiographic inspection of the arm showed a fracture of the radial head, proximal migration of the radius, and subluxation of the DRUJ joint. McDougall and White opted to excise the radial head, and similarly to Essex-Lopresti's first case, the patient experienced dislocation and arthritis of the wrist as well as weakness of grip. This case again displayed the importance of avoiding radial head excision for this type of injury, as it led to further migration of the radius and deformity at the wrist.

Despite Essex-Lopresti's suggestion in 1951 to use a radial head implant in cases of severe comminution, this was not reported until 1973 by Levin. The patient was 30 years old and fell from a bucking horse, landing with both arms extended.⁽¹⁷⁾ The patient presented with severe pain and swelling in both arms. Radiographs displayed bilateral radial head fractures. The right one was simple and easily reduced. The left forearm had proximal migration of the radius and disruption of the DRUJ. Levin treated this Essex-Lopresti injury with excision of the radial head and immediate replacement with a large silicone implant. The arm was put in a cast in full supination and partial elbow flexion. A year after surgery, the patient had regained full elbow and wrist motion in both arms and had regained all but 10 degrees of pronation in his left forearm. Although silicone implants had been used previously for comminuted radial head fractures, Levin used a silicone implant to treat an Essex-Lopresti fracture. This case also displayed how effective radial head replacement could be when treating the Essex-Lopresti injury, especially when the radial head is not salvageable.

Edwards and Jupiter contributed to the treatment of this injury by creating a classification system for different types of Essex-Lopresti injuries. In 1988, they reported on their treatment of 7 patients with Essex-Lopresti injuries.⁽¹⁾ They classified their patients into 3 groups. Type I cases included patients with radial head fractures with large displaced fragments. These patients were treated with open reduction and interfragmentary screw or pin fixation. Type II cases were those with severe comminution, which were treated with radial head excision and prosthetic replacement. Type III Injuries were old injuries with irreducible migration of the radius. These injuries were treated with radial head replacement and ulna shortening. Three patients had excellent outcomes, 2 good, one fair, and one poor. Of the patients with excellent outcomes, 2 had type I fractures, and one had a type II fracture. Of the patients with good outcomes, one had a type II fracture, and one had a type III fracture. The 1 patient with a fair outcome had a type III fracture. The 1 patient with a poor outcome had a type I fracture, but the patient refused further treatment after radial head resection. The study was important because the authors developed a classification system that could be used to guide treatment for patients with this injury. This classification system resembles the suggestions made by Essex-Lopresti 37 years prior. Unlike Essex-Lopresti,

however, Edwards and Jupiter also suggested a course of treatment for chronic cases using a silicone prosthesis.

Current Period (1990-present)

There have been a number of recent advances regarding both the diagnosis and treatment of this injury. The IOM is a hyperechoic structure, allowing it to be visualized using ultrasound. In 1999, Failla et al. used cadavers to show that it was possible to visualize and diagnose tears in the IOM.(18) (Figure 6A) They also used ultrasound to diagnose IOM injuries in 2 Galeazzi type fractures and 1 Essex-Lopresti fracture. (Figure 6B) In a cadaveric study, Jaakkola et al. demonstrated that ultrasonography diagnosis for IOM tear was accurate in 26/27 cases (96%).(19) They suggested that ultrasound could be used as a screening tool for tears of the IOM in patients with radial head fractures. Magnetic resonance imaging can also be used to diagnose Essex-Lopresti injuries, and it has been shown to have a similar accuracy rate to ultrasound.(20) Although the relatively low cost and ease of performing an ultrasound makes it an attractive tool in the diagnosis of IOM injuries, further studies in patients with IOM injuries are required before ultrasound can become the preferred diagnostic tool.

Current surgical treatment of this injury consists of open reduction internal fixation or replacement of the radial head and stabilization of the DRUJ. Recently, a number of authors have also attempted to repair or reconstruct the interosseous membrane. Failla et al. reported linear suture repair of the central third of the IOM in an acute Essex-Lopresti injury. They did this procedure after stabilizing the DRUJ and open reduction internal fixation of the radial head. However, a direct repair of the IOM may not be possible in all cases, and further studies are required to determine if the repaired IOM has the potential to heal and provide long-term stability. Reconstruction of the IOM has been suggested for chronic cases. These attempts at reconstructing the IOM were made because in some cases the IOM fails to heal. (21,22) This may be a result of herniation of the anterior compartment muscles.(18). Adams et al. used a bone-patellar tendon-bone graft to reconstruct the IOM. They performed this procedure on a 45-year-old woman with a chronic Essex-Lopresti injury. The patient underwent wrist arthroscopy, TFCC debridement, ulnar shortening osteotomy, and bone-patellar tendon-bone allograft reconstruction. (23) After 5 months, this procedure had decreased the pain in her elbow and resulted in good movement of the forearm and elbow. In addition to the bone-patellar tendon-bone graft, methods including flexor carpi radialis graft and pronator teres rerouting have been proposed for reconstruction of the IOM.(23–25) Further anatomical and biomechanical studies are required to assess the function of the IOM and the value of reconstructing this structure.(24–28)

Radial head prostheses have improved. Complications including fracture of the prosthesis and silicone synovitis were reported with silicone implants. Moreover, biomechanical testing in cadavers showed that silicone prosthetics did a poor job of restoring forearm stability. Hotchkiss found that in cadaver elbows, silicone prostheses were poor at resisting valgus stress. When the radial head was resected, the valgus stability decreased by 30%. Upon replacement with a silicone prosthesis, the increase in valgus stability was not improved to a statistically significant degree.(29) While valgus stability and longitudinal

stability are different, the fact that a silicone prosthesis cannot control valgus instability would suggest there may also be shortcomings when it comes to controlling longitudinal stability of the radius as well. In 1993, Knight et al. conducted a study of metal prosthesis replacement for patients with radial head fractures and found that their patients had good recovery of forearm rotation and elbow flexion. (30) Although 2 patients had loosening of the prosthesis, there were relatively few complications. The improved durability led to wider use of this type of prosthesis. However, complications with metal prostheses have also been documented including altered joint pressures, arthritis, and erosion of the capitellum.

The observations of Essex-Lopresti, along with surgical and diagnostic innovations, have contributed greatly towards the treatment of this injury. Nevertheless, there is still considerable room for improvement, especially for patients with chronic injuries. Further study is needed to improve radial head prosthetics and to determine the need and possible methods for interosseous membrane reconstruction. The rare occurrence of this injury makes conducting a large clinical study difficult. However, biomechanical studies may help to better understand the pathology of this injury and to develop effective treatment strategies.

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Figure 1.

Essex-Lopresti injury: This is characterized by a fracture of the radial head with an associated dislocation of the distal radioulnar joint and a tear of the interosseous membrane.

Figure 2.
Peter Essex-Lopresti (1915–1951) (Photograph courtesy of Dr. Michael Essex-Lopresti).

Figure 3.
Peter Essex-Lopresti operating at Birmingham Accident Hospital circa 1950 (Photograph courtesy of Dr. Michael Essex-Lopresti).

Figure 4.

The first documented case of an Essex-Lopresti injury. (Published with permission of the British Journal of Surgery Society Ltd. Curr JF, Coe WA. Dislocation of the inferior radio-ulnar joint. *Br J Surg.* Jul 1946;34:74–77.)

Figure 5a

Figure 5b

Figure 5c

Figure 5.

Radiographs of the first case described by Essex-Lopresti. This was treated with excision of the radial head. (Published with permission of the British Editorial Society of Bone and Joint Surgery. Essex-Lopresti P. Fractures of the radial head with distal radio-ulnar dislocation; report of two cases. *J Bone Joint Surg Br.* May 1951;33B(2):244–247.)

Figure 5A: Pre-operative radiograph of the elbow showing the comminuted radial head fracture.

Figure 5B: Post-operative radiograph of the elbow showing proximal migration of the radial shaft and impingement against the capitulum after radial head excision

Figure 5C: Post-operative radiograph of the wrist showing distal radioulnar joint subluxation and proximal migration of the radius

Figure 6a

Figure 6b

Figure 6.

Ultrasound of the interosseous membrane. Taken by Failla et al. (Published with permission of the Journal of Hand Surgery. Failla JM, Jacobson J, van Holsbeeck M. Ultrasound Diagnosis and Surgical Pathology of the Torn Interosseous Membrane in Forearm Fractures/Dislocations. *J Hand Surg.* March 1999;24A(2):257–266.)

Figure 6A: Ultrasound of the interosseous membrane. Arrows indicate an intact membrane.

Figure 6B: Ultrasound of a ruptured interosseous membrane in a patient with an Essex-Lopresti injury. Arrows indicate the edges of the ruptured interosseous membrane.