

## COLLES FRACTURE – HISTORICAL RETROSPECTION

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### SAŽETAK

U kraćem istorijskom osvrtu, autor hronološkim redom iznosi najznačajnije ličnosti u hirurgiji koje su proučavale “prelom radijusa na tipičnom mestu” (lat. *fractura radii loco typico*). Navode se i eponimi koji se uobičajeno koriste u svakodnevnoj praksi, uz ličnosti za koje se vezuju.

**Ključne reči:** fraktura, istorija

### ABSTRACT

The author presents a short historical retrospection of the most important surgeons who studied Colles fracture, in chronological order. The author also describes the eponyms most commonly used in daily surgical practice, along with the historical figures that they are linked to.

**Keywords:** fracture, history

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Prelom distalnog okrajka radijusa, u praksi često nazivan *fractura radii in loco typico* – mada je ispravniji termin *fractura radii in zona typica* – jedan je od najčešćih preloma sa kojima se hirurzi ili traumatolozi susreću u svom svakodnevnom radu. Njegova učestalost dovoljan je izazov za jedan kraći istorijski pregled, koji omogućava bolje razumevanje ove frakture [1,2].

Mada pisanih dokumenata nema, jedan istraživač je na ekshumiranoj egipatskoj mumiji otkrio frakturu sa intaktnom imobilizacijom daščicama, kakvu i danas susrećemo širom sveta u nedostatku modernih oblika imobilizacije [3].

Od vremena Hipokrata pa do početka XIX veka, prelomi distalnog okrajka radijusa su često pogrešno tumačeni kao iščašenje ručnog zgloba. U Hipokratovim radovima (V vek pre nove ere) nalazimo samo nejasne opise preloma podlaktice, mada je poznato da je on razlikovao luksacije zglobova i prelome nekih kostiju [4,5].

Ambroaz Pare (*Ambroise Paré*, 1510–1590) je prvi spomenuo mogućnost preloma radijusa i ulne [6].

Žan Luj Peti (*Jean Louis Petit*, 1674–1750) opisuje pomak fragmenata ustranu i po dužini, smatrajući da je za to odgovoran *musculus pronator teres* [7].

Do kraja XVIII veka, ovaj tip preloma nije bio dovoljno poznat, pa su se do tog vremena mešali pojmovi uganuće, iščašenje i prelom.

Klod Puto (*Claude Pouteau*, 1725–1775) bio je briljantni šef hirurgije u bolnici *Hôtel-Dieu de Paris* [1,7]. U delu štampanom posthumno (1783. godine) u Parizu, Puto je opisao prelome distalnog okrajka radijusa [8]. Opazio je da u ovom prelomu često nedostaju tipični klinički znaci – patološka pomičnost i krepitacije, pa se zbog toga mogu zameniti distorzija i luksacija, te diastaza radijusa i ulne. Puto opisuje prelome distalnog okrajka radijusa sa dorzalnim izbočenjem ili pomakom distalnog fragmenta. Prepoznavao je nekoliko vrsta frakture, čak i impaktirane, kod kojih nije mogao da izazove krepitacije [8]. Navedeni rad Kloda Putoa nije bio zapažen izvan Francuske tako da za njega nije znao Ejbram Koles kada je, 1814. godine, u Edinburgu publikovao svoj rad: „O prelomu distalnog okrajka radijusa“ [9].

Ejbram Koles (*Abraham Colles*, 1773–1843) bio je znameniti irski hirurzi i profesor anatomije na Irskom kraljevskom koledžu hirurgije (engl. *Royal College of Surgeons in Ireland*) [9–13]. Jasno i kratko je opisao najčešće konstatovanu frakturu distalnog okrajka radijusa. Ono što pomalo iznenađuje je da, mada odličan anatom i crtač, Koles ovaj svoj rad nije propratio ilustracijama i analizom ozleđivanja. Možda je to dovelo do toga da je Koles ovu frakturu locirao nešto proksimalnije [6,13–16]. Prema njegovom shvatanju prelom se nalazi otprilike inč i po (oko 4 cm) udaljen od radiokarpalnog zgloba, sa deformitetom zglobne površine, tako

Fracture of the distal end of the radius, in clinical practice commonly referred to as *fractura radii in loco typico* – although the more correct term is *fractura radii in zona typica* – is one of the most frequent fractures encountered by surgeons or traumatologists in their daily work. Its high incidence presents a sufficient reason for a brief historical overview, enabling a better understanding of this fracture [1,2].

Although there are no written records, a researcher discovered a fracture with intact immobilization with wooden splints on an exhumed Egyptian mummy, similar to the type of immobilization that can still be found worldwide in the absence of modern forms of immobilization [3].

From the time of Hippocrates until the beginning of the 19<sup>th</sup> century, fractures of the distal end of the radius were often mistakenly interpreted as dislocations of the wrist joint. In Hippocrates' writings (5<sup>th</sup> century BCE), only vague descriptions of forearm fractures can be found, although it is known that he distinguished between joint dislocations and fractures of certain bones [4,5].

Ambroise Paré (1510–1590) was the first author to mention the possibility of fracture of the radius and ulna [6].

Jean Louis Petit (1674–1750) described the displacement of fragments laterally and along the length of the bone, attributing this to the action of the *pronator teres* muscle [7].

This type of fracture was not well understood until the end of the 18<sup>th</sup> century, and the terms sprain, dislocation, and fracture were often confused.

Claude Pouteau (1725–1775) was the brilliant chief surgeon of the *Hôtel-Dieu de Paris* [1,7]. In an article published posthumously in 1783, in Paris, Pouteau described fractures of the distal end of the radius [8]. He observed that in this type of fracture, the typical clinical signs – abnormal mobility and crepitus – are often absent, which can lead to sprains, dislocations, or diastasis of the radius and ulna being confused with one another. Pouteau described fractures of the distal end of the radius with dorsal protrusion or displacement of the distal fragment. He recognized several types of fractures, including impacted ones, wherein crepitus could not be elicited [8]. Pouteau's article went largely unnoticed outside of France, and as a result, Abraham Colles was unaware of it when he published his paper *On the fracture of the carpal extremity of the radius*, in Edinburgh, in 1814 [9].

Abraham Colles (1773–1843) was a renowned Irish surgeon and Professor of anatomy at the Royal College of Surgeons in Ireland [9–13]. He described clearly and concisely the most commonly observed fracture of the distal end of the radius. What is somewhat surprising is that,

da odnos pri inspekciji podseća na luksaciju. Glavica ulne prominira prema napred i ka unutra. Edem u zoni loma nastaje zbog krvarenja među tetivama fleksora podlaktice. To je njegovo objašnjenje zašto pacijent ima bolove prilikom pronacije, supinacije i provokacije fleksije. Nema krepitacije, kao ni patološke mobilnosti. Ukoliko se pacijent povuče za šaku, nastali deformitet se ispravlja, ali odmah nakon otpuštanja ekstremiteta, deformitet se ponovo manifestuje. Značajno je da je Koles opisao pomak uzdužne osovine ruke u radijalnu stranu. I ovaj rad je objavljen u lokalnom medicinskom časopisu, pa je ostao nezapažen [9].

Baron Gijom Dipitren (*Gulliam Dupuytren*, 1777–1835) je još studentima ukazivao na ovaj prelom radijusa na svojim predavanjima. On kaže, u jednom svom radu, objavljenom posthumno, 1847. godine, „da je uočio činjenicu da su mnogi pogrešno dijagnostikovali prelome distalnog okrajka radijusa kao luksacije ručnog zgloba“ [18,19]. Nadalje, on ističe da je fraktura karpalnog kraja radijusa česta, i da je uvek u tom prelomu video pretpostavljenu dislokaciju ručnog zgloba, mada se nije radilo o iščašenju [20].

Žan Gaspar Blez Guaran (*Jean-Gaspard Blaise Goyrand*, 1803–1886) je bio izvanredan hirurg u Eksu (nedaleko Marselja) [1]. Razlikovao je epifizeolize i prelome distalnog okrajka radijusa od radio-karpalnih iščašenja. Zapazio je prominiranje distalnog kraja ulne udružene sa avulzijom stiloidnog nastavka ulne. Uočio je i to da je, kod najvećeg broja fraktura, distalni fragment pomeren dorzalno, mada u nekim slučajevima opisuje i pomeranje ulomaka prema dlanu. Oba tipa ovih preloma ilustrovao je u svojim radovima 1832. godine, odnosno 1836. godine [21,22].

Ogist Nelaton (*Auguste Nelaton*, 1807–1873) je proširio anatomske studije preloma opisujući različite varijacije ozleda i stepene kominucije. Intenzivno je eksperimentisao sa mehanizmima povređivanja na kadaverima. Podlaktice umrlih dezartikulisao je u laktu i uklanjao olekranon. Sa fiksiranom šakom – u dorzalnoj ili volarnoj fleksiji, i vertikalno uspravljenom podlakticom – lomio je čekićem gornji kraj podlaktice. Tako nastale prelome radijusa je disecirao i upoređivao sa mehanizmom povrede. Nelaton upozorava na značaj malih kostiju u području korena šake, pošto se u času pada čovek po pravilu dočekuje na ispruženu ruku u dorzalnoj fleksiji šake. Pri tom, udarac primaju na sebe karpalne kosti, te se čunkasta kost utiskuje u distalni kraj radijusa. Iz ovoga je vidljivo da je Nelaton pristalica Dipitrenove teorije udara i protivudara (fr. *coup et contrecoup*) [23,24].

Alfred Arman Lui Mari Velpo (*Alfred-Armand-Louis-Marie Velpeau*, 1795–1866) je posebno zanimljiva ličnost u istoriji medicine. On je eklatantan primer za to kako čovek neumornim radom i snagom volje može

despite being an excellent anatomist and illustrator, Colles did not accompany this publication with illustrations or an analysis of the injury mechanism. This may have led him to define the location of the fracture slightly more proximally than it actually occurs [6,13–16]. According to his understanding, the fracture is situated approximately an inch and a half (around 4 cm) from the radiocarpal joint, with a deformity of the articular surface, which makes it appear, on inspection, as a dislocation. The head of the ulna protrudes forward and inward. Swelling at the fracture site arises due to bleeding between the forearm flexor tendons. This, he explained, is why the patient experiences pain during pronation, supination, and elicited flexion. There is no crepitus nor pathological mobility. If the patient's hand is pulled, the deformity is corrected; however, once the limb is released, the deformity reappears. Notably, Colles described a shift of the longitudinal axis of the hand toward the radial side. This article was also published in a local medical journal and thus remained largely unnoticed [9].

Baron Guillaume Dupuytren (1777–1835) had already been pointing out this type of radial fracture to his students during his lectures. In one of his studies, published posthumously in 1847, he stated that “he had observed many cases of mistakenly diagnosed fractures of the distal end of the radius as dislocations of the wrist joint” [18,19]. Furthermore, he emphasized that fractures of the carpal end of the radius were common and that he always observed what appeared to be a dislocation of the wrist in such fractures. However, it was not actually a dislocation [20].

Jean-Gaspard Blaise Goyrand (1803–1886) was an exceptional surgeon from Aix (near Marseille) [1]. He made a distinction between epiphysiolysis and fractures of the distal end of the radius, on the one hand, and radiocarpal dislocations, on the other. He noted the prominence of the distal end of the ulna, often accompanied by an avulsion of the ulnar styloid process. He also observed that in the majority of fractures, the distal fragment was displaced dorsally, although in some cases he described displacement of the fragments toward the palm. He illustrated both types of these fractures in his works published in 1832 and 1836 [21,22].

Auguste Nélaton (1807–1873) expanded anatomical studies of fractures by describing various injury patterns and degrees of comminution. He conducted extensive experiments regarding injury mechanisms using cadavers. He disarticulated the forearms of the deceased at the elbow and removed the olecranon. With the hand fixed, in either dorsal or volar flexion, and the forearm positioned vertically, he struck the upper part of the forearm with a hammer to induce frac-

da napreduje od neukog pastira do jednog od najvećih autoriteta operativne hirurgije. Bio je manuelno spretni operater, vešt govornik, pronicljiv dijagnostičar, te marljivi stručan pisac. Krasile su ga savršena jasnoća i preciznost izražavanja. Prvi je koji je deformitet koji se javlja u prelomu distalnog okrajka radijusa nazvao *talon de fourchette*, što su anglosaksonski autori, 1859. godine, preveli kao deformitet u obliku srebrne viljuške (engl. *silver fork deformity*) [1,11,25,26].

Godine 1838, Džon Rija Barton (*John Rhea Barton*, 1794–1871) je opisao dislokacionu frakturu radio-karpalnog zgloba, koja je kasnije eponimski povezana sa njim [1,13,27,28]. Barton opisuje dva tipa preloma: prvi, sa dorzalnim pomakom fragmenata, i drugi, ređi tip, sa palmarnim pomakom. Kao i Robert Viljem Smit, devet godina kasnije, Barton je kao dorzalni pomak verovatno opisao Kolesovu frakturu. Opazio je da se prelom obično završava nepovoljno po bolesnika. Barton jasno opisuje subluksaciju ručnog zgloba kao posledicu preloma koji zahvata artikulacionu površinu karpalnog kraja radijusa i naglašava da su – pri ovom nesrećnom padu – često slomljeni radijus i ulna, ali da zglob nije luksiran [27,28].

U svojoj „Studiji o prelomima u blizini zglobova i nekim oblicima traumatskih i kongenitalnih luksacija“, Robert Viljem Smit (*Robert William Smith*, 1807–1873) je, 1847. godine, objavio poglavlje o prelomima kostiju podlaktice u blizini ručnog zgloba [30]. Ono sadrži: anatomske opis Kolesove frakture, opis separacije distalne epifize radijusa, kao i opis preloma distalnog okrajka radijusa sa pomakom donjeg ulomka prema napred i sa dorzalnom angulacijom – Smitov prelom. Kao i Guaran, i Smit je analizirao postmortalne patoanatomske supstrate sraslih preloma, s tim što im se opisi odnose na klinička stanja i kliničku sliku, što svakako doprinosi nejasnoći pojma opisanog kao dorzalna prominencija distalnog okrajka radijusa. Smit to i ističe kad kaže da ne može sa sigurnošću da govori o anatomskom svojstvu preloma jer nije imao prilike da analizira sveži prelom već, postmortalno, skelet podlaktice nakon već sraslog preloma koji je pacijent tokom svog života nekada pretrpeo. On opisuje palmarni pomak distalnog ulomka radijusa i dislokaciju donjeg radio-ulnarnog zgloba. Moguće je da je prelom koji opisuje Smit ono što je danas poznato kao Bartonov prelom, ali je sam eponim – već poodavno povezan za Smitom – poznat i kao obrnuti Kolesov prelom uzrokovan padom na dorzum flektirane šake [30,31].

Narednih nekoliko decenija napori istraživača bili su usmereni na anatomske sekcije i eksperimente na leševima, u pokušajima da se razjasne tipovi preloma i njihov odnos sa mehanizmima povrede. Tako, M. Didej (*M. Diday*) uočava neke zakonitosti u frakturnoj pukotini. On smatra da je lom posledica rezultante dveju sila koje bi se mogle matematički izračunati [32].

He then dissected these resulting radial fractures and compared them to the injury mechanisms. Nélaton emphasized the importance of the small bones in the wrist region, noting that during a fall, a person typically lands on an outstretched hand in dorsiflexion. In such cases, the carpal bones absorb the impact, and the scaphoid is driven into the distal end of the radius. From this, it is clear that Nélaton supported Dupuytren's theory of impact and counter-impact (Fr. *coup et contrecoup*) [23,24].

Alfred-Armand-Louis-Marie Velpeau (1795–1866) is a particularly fascinating figure in the history of medicine. He is a striking example of how a person, through tireless work and great willpower, can rise from an uneducated shepherd to one of the greatest authorities in operative surgery. He was a manually skillful surgeon, an eloquent speaker, a perceptive diagnostician, and a diligent and knowledgeable writer, known for his perfect clarity and precision of expression. He was the first to describe the deformity that appears in fractures of the distal end of the radius as *talon de fourchette*, a term that English-speaking authors referred to, in 1859, as the *silver fork deformity* [1,11,25,26].

In 1838, John Rhea Barton (1794–1871) described a dislocation fracture of the radiocarpal joint, which was later associated with him through an eponym [1,13,27,28]. Barton described two types of fractures: the first with dorsal displacement of the fragments, and the second, a rarer type, with palmar displacement. Like Robert William Smith, nine years later, Barton most likely described a Colles fracture as one with dorsal displacement. He observed that the fracture usually ended unfavorably for the patient. Barton clearly described subluxation of the wrist joint as a consequence of a fracture involving the articular surface of the carpal end of the radius and emphasized that in such unfortunate falls, the radius and ulna are often fractured. However, the joint itself is not dislocated [27,28].

In his *Treatise on Fractures in the Vicinity of Joints, and on Certain Forms of Accidental and Congenital Dislocations*, Robert William Smith (1807–1873) published, in 1847, a chapter on the fractures of the bones of the forearm, in proximity to the wrist joint [30]. It includes an anatomical description of Colles fracture, a description of distal radial epiphyseal separation, as well as a description of the fracture of the distal end of the radius with palmar displacement of the distal fragment and dorsal angulation – now known as a Smith fracture. Like Goyrand, Smith analyzed postmortem pathological specimens of healed fractures. However, their descriptions relate to clinical conditions and presentations, definitely contributing to the ambiguity of the term – dorsal prominence of the distal radius.

Tek otkrićem iks zraka Vilhelma Konrada Rendgena počinje egzaktno razjašnjavanje patoanatomskog supstrata preloma distalnog okrajka radijusa [33].

U oktobru 1897. godine, organizovan je sastanak lekara Nemačke poliklinike u Njujorku. Tada je Karl Bek (*Carl Beck*, 1865–1911), američki hirur, obavestio skup o tome da je počeo da koristi rendgenske zrake tri meseca nakon Rendgenovog objavljenog otkrića, 1896. godine, te da je do tada analizirao 44 bolesnika sa Kolesovim prelomom. Pri tome je zaključio: „Što se mene tiče moram da zapazim da niko pre mene nije to opisao, tako da nisam video primer u kome je dijagnoza potvrđena pre rendgenskog snimka – jer, svi autori opisuju postojanje deformiteta, otoka i bolne osetljivosti u tom predelu“ [34].

Drugi entuzijasta koji je koristio rendgenske zrake je bio Frederik Koton (*Frederick Cotton*) iz Bostona. On je objavio sličan rad o 140 bolesnika sa prelomima distalnog okrajka radijusa, te opisao eksperimentalne i anatomske korelacije koje je uočio na rendgenskim snimcima [35–37].

U prvom kvartalu prošlog veka (1900–1925), za vreme nagle ekspanzije automobilizma, u literaturi se pojavio termin šoferska fraktura, koju je opisao Emil Kude (*Emile Coude*). Naime, prilikom mehaničkog paljenja automobila ručnim pokretačem (kurblo), vozači su često povređivali ruku. U anglosaksonskoj literaturi, ekvivalentno značenje imao je pojam *backfire fracture*, što je, 1926. godine, razjasnio Edvards (*H. C. Edwards*) [1,38].

Nadalje su se problematikom preloma distalnog okrajka radijusa zanimali, između ostalih: Desto (*Destot*), Pilčer (*Pilcher*), Majer (*Mayer*), Morton (*Morton*), Klajnsmit (*Kleinschmidt*), Olerud (*Olerud*), Lidstrom (*Lidström*), Ehalt (*Ehalt*), Frikman (*Frykman*), de Bron (*de Bruijn*), Hančević i mnogi drugi. Svi oni uočavaju veliku šarolikost preloma distalnog okrajka radijusa kao i varijante u pomaku fragmenta, pa misao Spida (*K. Speed*) kako nema dve jednake Kolesove frakture – izražena još davne 1935. godine – najbolje ukazuje na svu komplikovanost preloma distalnog okrajka radijusa, kojeg u svakodnevnoj praksi najčešće nazivamo *fractura radii in loco typico* [7,39].

Zaključujući ovaj kratki istorijski pregled poimanja frakture radijusa u tipičnoj zoni, treba uvažiti činjenicu da su se do danas u literaturi održali samo eponimi koji jasno definišu tipove preloma, i to:

1. Kolesov prelom (u anglosaksonskoj literaturi), odnosno Puto-Kolesov prelom (u francuskoj literaturi)
2. Bartonov – volarni i dorzalni prelom
3. Smitov ili inverzni (obrnuti) Kolesov prelom [1,40,41].

**Sukob interesa:** Nije prijavljen.

Smith himself acknowledged this, stating that he could not speak with certainty about the anatomical nature of the fracture because he did not have the opportunity to examine a fresh fracture, only the skeletal forearm of a patient who had suffered the injury in his lifetime and whose fracture had already healed by the time of analysis. He described palmar displacement of the distal fragment of the radius and dislocation of the distal radioulnar joint. The fracture Smith described may correspond to what is known today as a Barton fracture, but the eponym – long since associated with Smith – also refers to what is called a *reverse Colles fracture*, caused by a fall onto the dorsum of the flexed hand [30,31].

In the ensuing decades, researchers focused their efforts on anatomical dissections and experiments on cadavers in attempts to clarify the types of fractures and their relationship to injury mechanisms. Thus, M. Diday observed certain patterns in fracture lines. He believed a fracture to be the consequence of the resultant force of two separate forces, which can be mathematically calculated [32].

It was only with the discovery of X-rays, by Wilhelm Conrad Röntgen, that the precise elucidation of the pathoanatomical substrate of distal radius fractures began [33].

In October 1897, a meeting of doctors from the German Polyclinic in New York was organized. At that time, Carl Beck (1865–1911), an American surgeon, reported that he had begun using X-rays three months after Röntgen's discovery was published in 1896, and that by the time of the meeting, he had analyzed 44 patients with Colles' fracture. He concluded: "As far as I am concerned, I must note that no one before me had described this, so I had not seen a case in which the diagnosis was confirmed before the X-ray image – because all authors describe the presence of deformity, swelling, and tenderness in that region" [34].

Another enthusiast who used X-rays was Frederick Cotton from Boston. He published a similar study on 140 patients with fractures of the distal end of the radius and also described experimental and anatomical correlations he observed on the X-ray images [35–37].

In the first quarter of the last century (1900–1925), during the rapid expansion of motor vehicle use, the term *chauffeur fracture* appeared in the literature, described by Emile Coude. Namely, while manually starting a car with a hand crank, drivers often injured their hands. In literature published in the English language, the equivalent term was *backfire fracture*, more precisely described by H. C. Edwards in 1926 [1,38].

The issue of distal radius fractures was further addressed by a number of researchers, including Destot,

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Concluding this brief historical overview of the understanding of radial fractures in the typical zone, it is important to acknowledge the fact that, to this day, only those eponyms that clearly define fracture types have remained in the literature, namely:

1. Colles fracture (in the literature published in English), or Pouteau-Colles fracture (in French literature)
2. Barton fracture – volar type and dorsal type
3. Smith fracture or the reverse (inverted) Colles fracture [1,40,41].

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