

COLLES FRACTURE

oleh:
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ABSTRACT **Colles Fracture**

The wrist is an essential link of the forearm to the hand and form the foundation of the hand. Any injury pertaining to it will decrease or may be disable the basic function of the hand. Colles fracture is the most common fracture of the wrist, amounting to an incidence of 24% in a working population, in which a fracture through the radius causes the distal fragment to be displaced radially and dorsally. It is the most common fracture in adults older than age 50 years and affected women more frequently than men, due to the onset of postmenopausal osteoporosis with a fall on the outstretched hand as the most common cause. The complication of Colles' fracture include mal-union, delayed rupture of extensor pollicis longus, posttraumatic reflex symphathetic dystrophy, nerve problems (especially median nerve), finger and shoulder stiffness, radiocarpal arthritis and associated scaphoid fracture. Treatment of Colles' fracture generally is by closed reduction and application of a plaster splint with exercises to restore and maintain mobility of the wrist and full functioning of the hand. However, sometimes orthopedic surgeon via external or internal fixation may be required.

Key words: Colles fracture, wrist fracture

ABSTRAK **Fraktur Colles**

Pergelangan tangan merupakan bagian penting yang menghubungkan lengan bawah dengan tangan dan membentuk dasar dari tangan. Cedera apa pun yang terjadi padanya akan menurunkan bahkan dapat meniadakan fungsi dasar dari tangan tersebut. Fraktur Colles merupakan fraktur pergelangan tangan yang paling sering ditemukan, dengan insidens sebesar 24% di antara populasi pekerja, dimana fraktur yang melalui radius menyebabkan bagian distalnya tergeser secara radial dan dorsal. Fraktur Colles juga merupakan fraktur yang paling sering terjadi pada orang dewasa berusia lebih dari 50 tahun dan lebih sering terjadi pada wanita dibandingkan dengan pria. Hal ini disebabkan karena dimulainya osteoporosis pasca menopause dimana jatuh dengan tangan terjulur merupakan penyebab tersering. Komplikasi fraktur Colles antara lain adalah mal-union, robekan ekstensor polisis longus yang tertunda, distrofi refleks simpatis pasca trauma, gangguan saraf (terutama nervus medianus), kekakuan jari dan bahu, arteritis radiokarpal, dan fraktur skafoid yang berkaitan. Penatalaksanaan Fraktur Colles' umumnya adalah dengan reduksi tertutup dan aplikasi gips dengan latihan untuk mengembalikan dan mempertahankan mobilitas pergelangan tangan serta fungsi penuh dari tangan. Namun, kadang-kadang bedah ortopedik melalui fiksasi eksternal atau internal diperlukan.

Kata-kata Kunci: fraktur Colles, fraktur pergelangan tangan

INTRODUCTION

Since the wrist is the foundation of the hand hence injuries can disable its basic function. Common occurrences are finger stiffness and weakness of grip following fractures of the distal radius, the painful grip of an ununited navicular, and persistent symptoms after a trivial wrist sprain.¹ Wrist is an essential link of the forearm to the hand² and has the mobility to place the hand in multiple spatial orientations.¹ Once positioned, the bones, ligaments and primary motors of the wrist provide the stable base necessary to support the functional forces generated as in power grip¹ thus any wrist injury will ultimately affect hand function. There were 24% of such hand disability incidence in a working population³.

The most common fracture of the wrist is the Colles' fracture in which a fracture through the radius causes the distal fragment to be displaced radially and dorsally.⁴ The distal radius is fractured more frequently than any other bone in the body.⁵ It is the most common fracture in adults older than age 50 years and affect women more

frequently than men^{6,7} due to the onset of postmenopausal osteoporosis⁸ with the most common cause is a fall on the outstretched hand which is also affected by the endogenous quality of the skeletal and ligamentous structures.^{5,8,9} The complication of Colles' fracture include malunion, delayed rupture of extensor pollicis longus, posttraumatic reflex symphathetic dystrophy, nerve problems (especially median nerve), finger and shoulder stiffness, radiocarpal arthritis and associated scaphoid fracture.^{1,6,8,10,11}

In general, Colles' fracture is treated by closed reduction and application of a plaster splint^{12,13} but Colles' fracture with significant comminution can only treated by orthopedic surgeon via external or internal fixation.¹² More importantly there is also the role of exercises and splint either static or dynamic to restore and maintain mobility of the wrist which is very essential for full functioning of the hand.⁵

Anatomy and Kinesiology of the Wrist

The wrist is subdivided into the following anatomical units: radius and

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radiocarpal joint, ulna and distal radioulnar joint, carpal mechanism and carpometacarpal articulations. The radius, which plays a secondary role at the elbow, becomes the dominant bone at the wrist, being responsible for the entire bony articulation between the forearm and the hand and thus subject to the major forces in falls on the outstretched hand. This shock-absorbing role is compromised by the cancellous structure and thin cortical veneer of the flared distal radius.¹

The radiocarpal joint is the synovial lined articulation between the forearm and the hand. Four surfaces and the radiocarpal joint are present at the distal of the radius. Its joint surface tilts volarly as well as ulnarward and has two concave facets that articulate with the navicular and lunate. The posterior surface is slightly convex with grooves locating the extensor tendons. This close apposition of tendon and bone, which crosses a dorsal prominence, is a frequent site of posttraumatic rupture. In the lateral, the bone projects to the radial styloid, site of both the brachioradialis insertion and the radial collateral ligament attachment. In the medial, the radius has an articular cartilage-lined concavity that articulates with ulna. The anterior surface is also concave and covered by the pronator quadratus, over which the flexor tendons and median nerve pass as they enter the carpal canal.¹

In addition, there is a structure called triangular fibrocartilage (articular disc) that originates from the medial aspect of the radius and inserts at the base of the ulnar styloid, separating the radiocarpal from the distal radioulnar joint and isolating the ulna from direct articulation with the carpal bones. In 30 to 60% of cases, this cartilage is perforated, allowing communication between the 2 joints.¹⁴ The lateral two

thirds of the head is articular cartilage, which forms the corresponding gliding surface around which the radius rotates.¹⁵ The styloid process of ulna has a variable extension beyond the head, and that is why the ulna is normally shorter (negative) than the radius distally but becomes positive in the Colles' fracture.¹⁶

Motion of the wrist joint consists of volar flexion about 75° (normal) and 15° (functional), dorsiflexion (extension) about 70° (normal) and 30° (functional), radial deviation about 20° (normal) and 10° (functional), ulnar deviation about 35° (normal) and 15° (functional). Pronation and supination is forearm motions involving the radioulnar joint with range of pronation is the same as supination: about 90° (normal)¹ and 50° (functional).¹⁶

The extensor carpi ulnaris tendon lies on the posterior aspect of the ulna, lateral to the styloid process.¹ With the ulna's adjustment to full pronation, its functional pull is that of an ulnar deviator rather than a wrist extensor.¹⁷ The ulnar styloid lies within a synovial diverticulum which communicates with the radiocarpal joint.¹⁸ The neck and tip of the ulnar styloid have no direct ligamentous attachment, as such, most styloid fractures represent avulsion fractures and occur at the basal level.¹

The intrinsic stability derives from the triangular fibrocartilage, which blends with the volar and dorsal radioulnar ligaments.¹⁹ The depth and bony configuration of the articulation is an additional element in intrinsic stability. Extrinsic stabilizers are related to the rotational position of the joint and include the effect of extensor carpi ulnaris¹⁷, the pronator quadratus²⁰, the crossed radial and ulnar shaft in pronation²¹ and the interosseus membrane. Any shortening of one of the forearm bones or loss of elbow

biomechanics alters the function of the distal radioulnar joint.¹

Definition, Epidemiology and Classification

Colles' fracture represents over 90% of all distal radial fractures and is named after Abraham Colles, an Irish surgeon who in 1814 described a type of transverse fracture of the radius just above the wrist with dorsal displacement of the distal fragment.^{1,8,13,22} About half the cases this fracture can happen with or without concurrent ulnar styloid fracture.^{5,9,17,23} In the European literature, it is known as Pouteau's fracture and is also called "dinner fork deformity" with prominence on the back of the wrist and a depression in front.^{1,6-8,13}

The classic deformity in Colles' fracture has components^{1,4,7,10,12,22}: dorsal and radial displacement of the distal fragment, dorsal angulation of the distal radial articular cartilage, and Shortening and loss of radial length. Colles' fracture usually happens to adults over 50 years of age and seven times more often in women than in men.^{1,7,10} in which osteoporosis is a frequent contributory factor.¹⁰ Osteoporosis is five times more prevalent in aging women than in men and develops rapidly at menopause.²⁴ The most common fractures related to postmenopausal osteoporosis are Colles' fracture, humeral neck fracture and hip fracture²⁵ and osteoporosis contributes to 1.3 million bone fracture/year in people over 45 years of age. An additional 15-20% of women aged 60 to 80 years will suffer a Colles' fracture.²⁶

Although it is not used universally, the Frykman classification is helpful as a general guide to the complexity of the fracture and its prognosis because the system distinguishes between extraarticular and intraarticular fracture and whether

an ulnar styloid fracture is present or not.¹² There are 8 categories of fracture in Frykman classification. Even-numbered fractures (type II, IV, VI and VIII) have an associated fracture of the distal ulna. Types III through VI are intraarticular fractures. Type I and II are extraarticular and have joint involvement, type III and IV involve radiocarpal joint, type V and VI involve radioulnar joint while type VII and VIII involve both radiocarpal and radioulnar joint. Higher numbers in the classification have worse prognoses.^{27,28}

There is also classification according to Destot which distinguished two main groups of distal radial fracture (anterior and posterior) and further divided them according to the line of fracture, differentiating extraarticular fractures, such as the classic Colles and Smith fractures, from those that are intraarticular, such as Barton's and radial styloid fractures.²⁹

Mechanism of injury^{1,4,7,23,26-28,30}

The wrist is the major shock absorber in a fall on the outstretched hand. The factors that determine the resulted specific injury are the position of the wrist at impact, the physical properties of the bones and ligaments, the magnitude of the injuring force and the rate at which the stress is applied. Sprains of this joint are rare, but displacement of the radial epiphysis is common in children. For example a force directed against the palm of a dorsiflexed wrist displaces fragments differently from a similar force against the dorsum of a volar flexed wrist. Hence in fractures of the distal radius, the former results in the common dorsal angulation of the Colles' fracture, whereas the latter in the rarer volar displacement of a Smith fracture. Interestingly, the greater the dorsiflexion, the greater was the force

required to make fracture in the distal radius and more likely in navicular and other carpal injuries.

Aside from the direction of the force, both the magnitude and the rate of loading determine the type of injury produced. Both these factors must exceed a certain critical value that is dependent on the physical properties of the bone and soft tissue prior to fracture. Given the age-related changes in these structures, the degree of trauma needed to produce a distal radial fracture varies inversely with age. The equivalent fracture in a child or older adult following a simple fall requires a fall from a height or a traffic accident in a young adult. Such age-related differences might also be expected to apply to the rate of applied load, with a more slowly applied stress causing fracture in the older age group.

While proportional to both the amount and the rate of the applied load, the extent and nature of the injury are also related to certain endogenous factors such as the anatomical peculiarity of the region – for example, the contact surface of the distal radius with the carpus and the lack of such contact by the ulna. In addition, there is a progressive change in the resistance of bone to fracture, which is both age- and sex-dependent such that there is a dramatic rise in distal wrist fractures in postmenopausal women that parallels the decreased severity of the traumatic mechanism. The tensile strength required to break the distal radius is 50% greater in the male skeleton. Thus whilst the nature of trauma is less severe, the greatest fracture displacement occurs in the aging population and the incidence of secondary radial collapse is higher. However, the endogenous quality of the skeletal and ligamentous structures is the dominant factor in most fractures of the distal radius.

Assessment

From history taking, usually there is a trauma involving forearm while from physical examination, there are associated findings include marked swelling of the dorsal aspect of the wrist, point tenderness across the dorsum and painful motion. The corresponding hump in the fractured arm occurs from dorsal displacement of the distal radial fragment, above the wrist. To exclude a hump from soft tissue swelling, palpate the volar aspect of the radius and compare it with its uninjured arm, the normal anterior convexity of the shaft which is obliterated below the fracture.⁹ On palpation of the ulnar side of the joint, there is point tenderness and a dorsal prominence of the ulna as well as a more proximal position of the tip of the radial styloid.¹³

It is also important to rule out the presence or absence of a concomitant median nerve injury.¹³ Although other injuries in the arm occurring in association with Colles' fracture are uncommon, the scaphoid, elbow and shoulder should be examined clinically. If there is pain in the wrist and tenderness over the distal end of the radius after a fall, x-rays must be taken in every case in at least two planes and preferably in three – anterior, lateral and oblique.¹⁰

The anterior view shows radial shortening and loss of the radial slope/radial articular angle (less than 15°).³⁰ Articular involvement, bony comminution, styloid fractures and ulnar variance can be observed. Disruption of the distal radioulnar joint is also apparent in the lateral view with either dorsal or volar displacement of the ulnar head.¹ In cases that are anatomically confusing, it is helpful to obtain x-rays of the normal uninjured wrist.

Treatment

Goals of treatment.²⁷ arerestoration of radial length, restoration of volar tilt,

restoration of anatomic articular congruity, and avoidance of complications. Besides those appropriate treatment considering the patient's physiologic age, functional demands, occupation and handedness, and early motion of a stable construction are also the goals of treatment. Controversial issues (because radial fractures do not respond well to fracture orthoses)³² surrounding the treatment of Colles' fracture¹ are the method of reduction, type of anesthesia used for reduction, criteria for acceptable reduction, position, type and duration of immobilization, and treatment of the severely comminuted intraarticular fracture

Undisplaced or stable Colles' fracture, which is uncommon, is one where main transverse fracture line with little cortical comminution⁶ and is treated with a dorsal splint applied for a day or two until the swelling has resolved as well as an above elbow cast to prevent pronation and supination. If the fracture is stable, the cast can usually be removed after 4 weeks to allow mobilization.^{5,8} The major impairments after cast removal are pain, swelling, decreased mobility and strength. Control of edema is critical to prevent a stiff hand. Elevation, ice, edema massage and compression garments can be used to reduce edema.

Many patients, however, complain of painful, stiff elbow, wrist, thumb and finger joints which may resulted from protective positioning and other minor soft tissue injuries sustained at the time of fracture. When many joints are involved, allow the patient to begin exercising in the water and if there is significant edema, contrast bath may be preferred.³³ Restore of mobility is essential for full functioning of the hand. The priority in the early phase of mobility exercises should be to regain wrist

flexion, extension and supination because they are usually the most limited motions and important for functional outcome.

Concerning casting, 3 principles are inviolate:¹

- i. No cast for Colles' fracture should extend beyond the metacarpophalangeal joint (knuckles) dorsally or the distal palmar crease volarly so as to permit full digital motion.
- ii. Any significant degree of edema or neurological symptoms following cast application necessitate splitting of the cast.
- iii. The best method to prevent disabling shortening in the wake of distal radial fracture is awareness of the problem and frequent clinical follow-up

A fracture requires reduction if:¹⁰ the fracture is grossly displaced or there is displacement of the ulnar styloid or the joint line in the lateral projection is tilted 10°, or the joint line in the lateral projection more posteriorly rather than anterior. Over 85% of Colles' fractures require some reduction.¹ Displaced fractures must be reduced under anaesthesia (local, extremity block and general anesthesia).⁶ The kind of anesthesia used should consider the patient's general health, recent food intake, associated injury, anesthetic risk, obesity and by the swelling and severity of the fracture. There are two ways to do close reduction: active manipulation and passive gravity traction (more popular).¹

The position is then checked by x-rays. If it is satisfactory, a dorsal plaster slab is applied, extending from just below the elbow to the metacarpal

necks and two-thirds of the way round the circumference of the wrist, which is then held in position by a crepe bandage. Besides palmar flexion and ulnar deviation, the forearm also held in supination.³⁴ The reasons for using supination in the treatment of Colles' fracture are as follows:

1. the forearm bones are parallel and not crossed as in pronation, permitting effective immobilization as well as easy radiological evaluation
2. the brachioradialis muscle inserting on the radial styloid is rendered ineffective as a distorting force
3. dorsal ulnar subluxations are reduced in supination
4. rehabilitation is easier, since gravity rotates the supinated forearm and each useful motion of the hand tends to pull it into pronation
5. any ultimate loss of forearm rotation is a loss of pronation which is easily compensated by humeral adduction

The arm is kept elevated for the next day or two; shoulder, elbow, the thumb and finger should be actively exercised hourly each day from the time of reduction.^{6,8} The thumb and fingers must be left free to move. If the fingers become swollen, cyanosed or painful, there should be no hesitation in splitting the bandage.⁸

Usually the cast extends only to the elbow (short arm cast), but if the fracture is very unstable, the elbow should be included in the cast (long arm cast), at least for the first 3 weeks, to maintain the forearm in complete pronation. Repeat radiographs are obtained one and two weeks after reduction because during this period the fracture may slip into an unsatisfactory position and up to the end of two weeks, the fracture is still sufficiently mobile that the position can

still improve, if necessary, by remanipulation.⁶ However, even if manipulation is successful, re-redispacement is common.⁸

The main problem in closed reduction is maintaining the reduction (immobilization). This dissatisfaction is related to the recurrence of the original deformity because the fractures often collapse due to severe comminution, intraarticular involvement or both.¹ Owing to the cancellous structure of the distal radius, the injury produces a triangular zone of compression of the dorsal and radial aspects, which become cavities when the fracture is anatomically reduced. This gap is initially filled with hemorrhage, gradually replaced by fibrous and cartilaginous tissue, and finally changed to spongy bone that bridges the fragments.³⁴ The incidence of such secondary displacement ranges from 40 to 70%³⁵ and usually occurs within the first 10 days.²⁸ The fracture unites in about 6 weeks and exercises may safely be initiated.^{8,36}

In comminuted Colles' fractures, plaster immobilization alone may be insufficient, hence must be supplemented by percutaneous K-wire fixation. The plaster and wires are removed after 5 weeks and exercises begun. In severe comminuted fractures for which percutaneous wires are inadequate, external fixation is needed.^{6,8} The basic principle of treatment is self-contained traction to prevent shortening of the radius at the fracture site.¹ The period of immobilization is eight weeks because radial shortening can occur with earlier pin removal.³⁷ However, sometimes primary resection of the distal end of the ulna in severely comminuted fractures of the radius is done because rapid healing occurred in the compressed radial fragments, permitting earlier mobilization and better functional

results.³⁸ Bone grafts may be added if the radius has markedly collapsed.

Complications

Most Colles' fractures are well united in an acceptable position within 6 weeks.⁶ The period of disability following Colles' fracture is influenced by factors such as age, severity of fracture, the relationship to a compensatory injury, and the activities expected of the wrist. In general, a period of three and one-half to four months is a reasonable time before full activity can be resumed.¹ Residual symptoms usually persist in 20% of all Colles' fractures but significant functional impairment occurs in only 10% and is related to complications of the injury.³⁹ Stiffness of the shoulder, elbow and fingers from neglect is common complication.^{1,6,8} while stiffness of the wrist may follow prolonged splinting.⁸

Complications and sequelae of Colles' fracture include loss of the volar distal articular tilt and the radial length. With this deformity, specific wrist motions are limited. Volar flexion and ulnar deviation are usually more restricted than dorsiflexion and radial deviation.²⁸ Loss of radial length can be severe and many patients complain of excessive fatigability and weakness of the hand and wrist. There are some weaknesses of grip strength in about 25 to 30% of patients.^{28,34,39}

Malunion is common, because reduction was not complete or displacement within the plaster was overlooked. The appearance is ugly and weakness and loss of rotation may persist. In most cases treatment is not necessary but if the disability is severe and the patient relatively young, the radial deformity should be corrected by osteotomy⁸ with or without excision of the distal end of the ulna. For an elderly patient, simple excision of the distal end

of the ulna is more appropriate.⁶ Ulnar involvement worsens the prognosis.^{28,39}

Dysfunction of the distal radioulnar joint is also a complication of Colles' fracture caused by radial shortening or by direct extension of the fracture into the joint. Symptoms include persistent tenderness over the ulna, weakness and pain on using the hand in pronation or supination functions, decrease in pronation and supination motions, and prominence of the distal ulna. Resection of the distal ulna helps improve forearm rotation.⁴⁰ Ulnar deviation of the hand can be prevented if less than 1 inch of ulna is resected, and distal ulnar stability can be prevented by surgically tethering the distal ulna to the extensor carpi ulnaris. Approximately 20% of avulsion fractures of the radial styloid fail to show bony union.

Incidence of nerve injuries occur with Colles' fractures^{1,8} ranging from 0.5%-3%²⁸ or 0%-6.3%⁴¹ and involving mostly the median nerve. Primary median nerve injury presents in the first six weeks, both that are present initially or one that develop during immobilization secondary to the excessive callus formation. Transient median nerve symptoms are common and usually caused by hemorrhage and swelling thus they respond to elevation and reduction of the fracture. Delayed median nerve injury or "tardy median nerve palsy" refers to the late onset of median nerve symptoms following a fracture that has healed either in malunion or with secondary degenerative disease.¹

Posttraumatic arthritis after Colles' fracture ranges from less than 5% to over 40% whilst rupture of the tendon of extensor pollicis longus has been reported in approximately 0.7% of Colles' fracture⁴² and usually develops from one to two months after

the fracture.⁶ The patient is unable to extend the distal phalanx of the thumb against resistance or to raise the thumb metacarpal away from the hand.

The incidence of reflex sympathetic dystrophy in Colles' fracture, which occurs in an extremity after operation or minor trauma¹¹ and particularly affects individuals who are fearful and inhibited,⁶ varies from 7-37%¹¹ or 1-16%.^{28,39}

CONCLUSION

Diagnosis of Colles' fracture is based on history taking, physical examination and radiographic examination. From history taking usually there is a trauma involving forearm. While through

physical examination associated findings include marked swelling of the dorsal aspect of the wrist that resemble dinner fork deformity as well as point tenderness across the dorsum and painful motion. Radiographic examination showed that there is radial shortening and loss of the radial slope/radial articular angle (less than 15°) in the anterior view; an articular surface involvement in oblique projections and a decrease of volar tilt (less than 0°) in the lateral view. Goals of treatment are to restore radial length, volar tilt, anatomic articular congruity and also to avoid any complications and make an early motion of a stable construction.

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