Epidemiology and Classification of Extensive Volar Wrist Lacerations: The "Spaghetti Wrist"

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Citation

Abstract

Objective: The aim of this study is to analyze the local epidemiological data, redefine and classify spaghetti wrist injuries as well as compare and contrast the prognostic implications of our classification with those in the literature.

Methods and Results: A review of surgical records between January 1991 and December 2002 found 164 men (82.8%) and 34 women (17.2%), with a mean age 27.5 years, were operated for spaghetti wrist lacerations. The frequency of spaghetti wrist was 16.5/year or 1.4/month. The annual rate of spaghetti wrists increased from 6.6% during 1991 to 1995, to 9.3% during 1996 to 2000, and to 10.4% during 2001 to 2002. Under 40 years, the women were 3.7 years younger than men were. Most frequent mechanism of injury was assault "cutlass" lacerations (39.4%). The ulnar nerve (73.1%), flexor carpi ulnaris (68%), and ulnar artery (61.7%) were the most commonly injured structures. In grade-1, ulnar triad structures were more commonly injured (46.3%) than the combined central superficial structures (33.3%). In Grade-3, most volar structures were transected. Delayed primary and secondary repairs were highest in grade-3 crush/avulsive (44.8%) spaghetti wrists. To include all variants, the spaghetti wrist was redefined as those "extensive volar wrist lacerations occurring between the distal wrist crease and musculotendinous junctions, involving a minimum of three volar structures (nerve, artery and a tendon) to at least ten structures, with or without one or more extensor tendons and bones".

Conclusions: This study shows that, there is an increase in spaghetti wrist injuries in our population over the last 5 to 8 years. Comprehensive definition and classification of spaghetti wrists can help in the study of the functional outcomes of all variants of this injury and thus develop better treatment protocols.

INTRODUCTION

Extensive volar wrist lacerations, also known as 'spaghetti wrist', 'suicide wrist' or 'full-house wrist syndrome' has been described extensively in the current literature, although there is no standard definition as to what constitutes a spaghetti wrist ([1]). The so-called "minimal definition" describes spaghetti wrist as an extensive volar wrist laceration involving a minimum of three completely transected structures (nerve, artery and tendon) to at least 10 divided structures inclusive of both ulnar and median nerves and ulnar and radial arteries ([2,3,4]).

Despite their relatively frequent occurrence in the civilian population, few data are available in the literature to classify these injuries; thus, a uniform reporting, severity of disability and prognosis are not available. A few reports attempted to categorize spaghetti wrist injuries as mild, moderate and severe, depending upon the number of volar structures involved excluding extensor tendon and bony

injuries ([1,2,3,4,5]). Transections of cutaneous nerves, major veins, and crush or avulsive lacerations were also excluded or not relevant in these studies ([1,2,3,4,5]).

The goals of this study are to (1) analyze the local epidemiological data of spaghetti wrist at General Hospital, Port-of Spain, Trinidad. (2) redefine the minimal definition of spaghetti wrist to a comprehensive definition to include all variants, (3) classify spaghetti wrist according to number and type of structures transected, type of lacerations, and type of repair, (4) compare and contrast the prognostic implications of our classification with those in the literature.

MATERIALS AND METHODS

A review of the surgical records of 199 patients between January and December 2002 for extensive volar wrist lacerations at the author's hospital was performed. Spaghetti wrist injuries were defined as lacerations occurring between the distal wrist crease and the flexor musculotendinous junctions involving at least three completely transected

structures, including at least one nerve, an artery and a tendon ([2]). To this minimal definition, as used by Puckett and Meyer, also included are all types of lacerations and structures including extensor tendons and bones. Data recorded are the age, sex, date of injury, mechanism of injury, type of laceration (sharp, crush/avulsive or infected), number and pattern of structures transected, and type of repair (primary, delayed primary or secondary).

OPERATIVE PROCEDURE

Any repair of structures done within the first 24 hours after injury is described as a primary repair, a delayed primary repair is done within 24 hours to 2 weeks, and after 2 weeks, it is a secondary repair ([6]). A sharp laceration is described as one with a single transection from skin to bone with sharp margins of all the structures involved, and usually a primary repair was possible. A crush/avulsive laceration is described as one with irregular margin, one or more transections of the involved structures, crushing with bony comminution, severe skin and neurovascular injuries requiring grafting ([6]) (Figures 1-6). An infected laceration is any laceration with features of infection of the wound that required wound debridement, treatment with antibiotics, and usually a primary repair was not possible.

Figure 1

Figure 1: A 40-year old man sustained an avulsive contaminated laceration to his left wrist and forearm. At exploration nine volar structures (ulnar nerve and artery, flexor carpi ulnaris, flexor digitorum superficialis 2-5, flexor digitorum profundus 4 and 5) and fourextensor tendons (extensor carpi ulnaris, extensor digiti minimi, extensor indicis and extensor pollicis longus) were completely transected. There was a vertical split fracture of distal shaft and head of ulna. Internal fixation of the fracture and delayed primary repair of tendons and nerve grafting was performed (Grade 2,A2B2).

Figure 2

Figure 2: Radiographs of the patient in figure 1 shows vertical split fracture through the distal shaft and head of the ulna.

Figure 3

Figure 3: A 29-year old man sustained a deep sharp laceration to his left wrist. At exploration, all sixteen volar structures (ulnar and median nerve, ulnar and radial artery, and all flexor tendons) and two extensor tendons (extensor carpi ulnaris and brachioradialis) were completely transected. Three carpal bones (scaphoid, lunate and pisiform) and the anterior surface of the distal end of the radius and the styloid process of the ulna were also lacerated. Primary repair of bones and vessels, and delayed primary repair of tendons and nerves was performed (Grade 3,A1B1B2).

Figure 4

Figure 4: Radiographs of the patient in figure 3 shows fractures of the pisiform, anterior surface of the distal end of the radius, and the styloid process of the ulna.
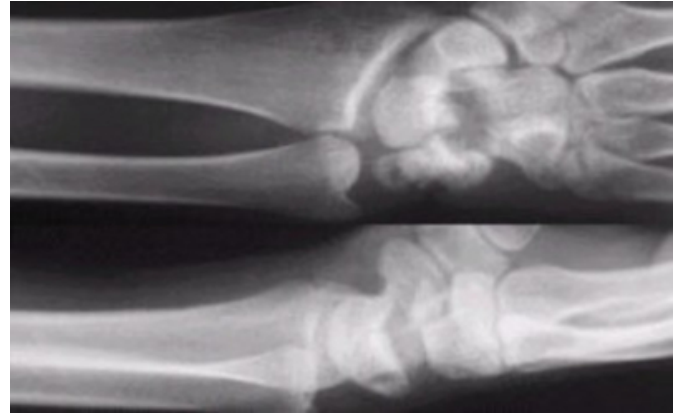

Figure 5

Figure 5: A 33 year old man sustained a deep crush/avulsive laceration to his left wrist. At exploration, fourteen volar structures (ulnar nerve and artery, median nerve, flexor carpi ulnaris, palmaris longus, flexor carpi radialis, flexor digitorum superficialis 2-4, flexor digitorum profundus 2-4) and three extensor tendons (extensor carpi ulnaris, extensor digiti minimi and extensor digitorum) were completely transected. Three carpal bones (pisiform, triquetrum and hamate) were lacerated. Primary repair of all structures was performed (Grade 3,A2B1).

Figure 6

Figure 6: Radiographs of the patient in figure 5 shows fracture of pisiform, triquetrum and hamate and partially separated mid carpal joint.

Under tourniquet control, extensile approach is obtained by extending the laceration proximally and distally by oblique or longitudinal incisions. The carpal tunnel is opened in patients with the laceration occurring at the distal wrist crease to facilitate exposure of the distal structures. A checklist of lacerated and normal structures is identified and recorded. Wounds are thoroughly irrigated with saline. Wound debridement is then dependent upon the type of laceration and the degree of contamination.

Fractures are fixed internally or stabilized by external fixator or the periosteum and capsule are sutured depending upon the number and type of bones involved and degree of displacement and instability. After the bones are fixed, the flexor and extensor tendons are repaired in deep to superficial fashion with 4-0 Prolene using a modified Kessler technique and reinforced with 6-0 Prolene continuous epitendinous suture. Some patients required tendon grafting or tendon transfer during secondary repair. Neurovascular structures are repaired under the loupe using 8-0 Prolene interrupted sutures. Most single artery transections (ulnar or radial) are ligated after the hand ischemia is clinically excluded. Nerves are repaired by epineurial or epiperineurial technique. Some patients required nerve and/or vascular grafting.

After surgery, patients are placed in a plaster splint with the wrist in 20 to 45 degrees of flexion, the metacarpophalageal joints in 40 to 60 degrees of flexion, and the interphalangeal joints are allowed to extend fully. At 0 to 4 weeks, active extension and passive finger flexion are performed. At 4 to 6 weeks, the flexion bands are removed and the patient begins protective progressive active flexion while continuing the

passive mobilization regimen. At 6 to 8 weeks, the splint is removed, tendon-gliding exercises are initiated and light activities of daily living exercises encouraged. At 8 weeks, blocking and light resistive exercises begin and at 12 weeks there is a return to full activity. Plaster splint was kept for extended period in patients who had osteosynthesis of fractures or fracture dislocations.

RESULTS

Patients' information retrieved from the hospital 'Surgical Procedures Register' between January 1991 and December 2002 indicate that 199 patients underwent operative procedures for extensive volar wrist lacerations, 'the spaghetti wrist'. One case of bilateral spaghetti wrist was excluded from the study. All 198 patients were included for epidemiological analysis only. Twenty-three patients were excluded from further analysis because of insufficient or unavailable patients' records leaving 175 patients for the study.

The occurrence of spaghetti wrists during the study period was at an average of 16.5 per year or 1.4 per month. During 1991 to 1995, it was 13.0 per year or 1.08 per month; during 1996 to 2000, 18.4 per year or 1.53 per month; and during 2001 to 2002, 20.5 per year or 1.71 per month (Figure 7). The highest yearly frequencies of spaghetti wrists occurred in 2002 (13.6 percent), 1996 (11.6 percent) and in 1998 (10.6 percent). The annual frequency of spaghetti wrist increased from 6.6 percent between 1991 and 1995 to 9.3 percent between 1996 and 2000, to 10.4 percent between 2001 and 2002. Forty-five percent of spaghetti wrists occurred during April to October at an average of 12.7 injuries per month (6.4 percent per month). Fifty-five percent of injuries occurred during November to December and January to March at an average of 21.8 per month (11.0 percent), representing an increase of 6.4 percent over January to March (Figure 8). This indicates that more number of spaghetti wrist injuries occurred in Trinidad during festivity and holiday seasons of the year.

Figure 7

Figure 7: Number of spaghetti wrist patients operated each year between Jan 1991 and Dec 2002.
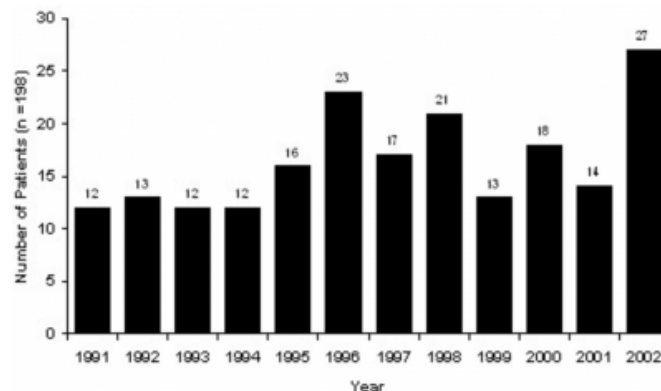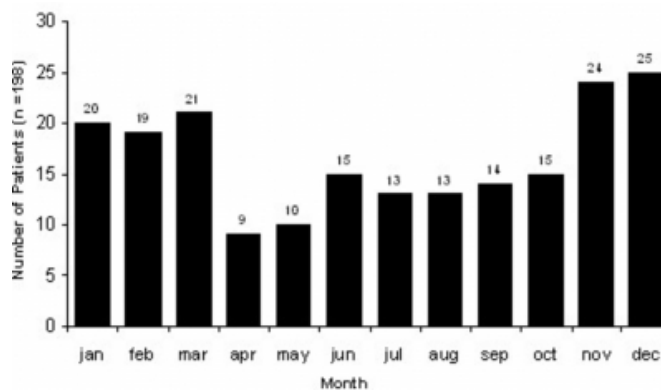

Figure 8

Figure 8: Monthly distribution of spaghetti wrist patients between Jan 1991 and Dec 2002.

The right sided spaghetti wrists were 89 (45.0 percent) while left sided were 109 (55.0 percent). Gender, age and ethnicity strongly influenced the incidents of spaghetti wrist injuries. One hundred and sixty-four men (82.8 percent) and 34 women (17.2 percent), with a mean age of 27.5 years (3 to 73 years), sustained spaghetti wrist injuries (Figure 9). Eighty percent of these patients were under 40 years (men 86.1 percent and women 13.9 percent) and on an average, the women (20.1 years) were 3.7 years younger than men were. Fifty-one percent were Afro-Trinidadian; 30.3 percent Indo-Trinidadians, and 18.7 percent mixed. The mechanisms of injury were assault 'cutlass' lacerations (39.4 percent), accidental glass and knife wounds (15.1 percent), industrial accidents (14.6 percent), suicide attempts (9.1 percent), power saw injuries (7.5 percent) and gun-shot injuries (3.5 percent). No mechanism of injury was recorded in 10.6 percent of patients' records.

Figure 9

Figure 9: Age and sex distribution of spaghetti wrist
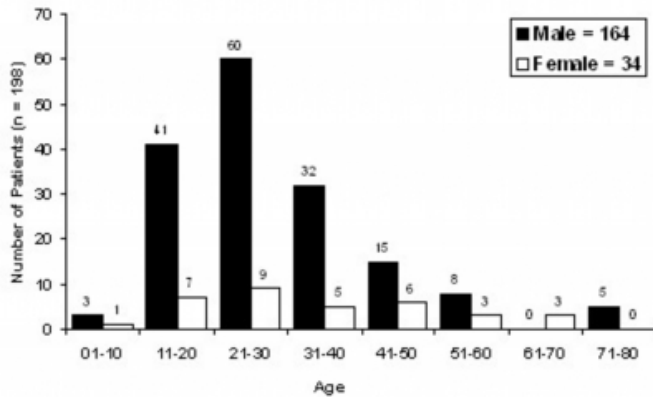
There was an average of 8.7 volar structures transected including 6.5 tendons, 1.4 nerves, and 0.9 arteries (Table 1). The most commonly injured structures were ulnar nerve (73.1 percent), flexor carpi ulnaris (68.0), median nerve (64.6 percent), ulnar artery (61.7 percent), and palmaris longus (61.1 percent), followed by combined one or more extensor tendons and bones (58.2 percent). Flexor digitorum superficialis 2-5 and flexor digitorum profundus 2-5 transections occurred in 56.0 percent and 47.8 percent of patients respectively. The flexor pollicis longus (41.7 percent) and radial artery (24.0 percent) were least transected structures. Combined flexor carpi ulnaris, ulnar nerve and ulnar artery (67.6 percent) were more frequently injured than the more superficial central structures combined, palmaris longus, median nerve and flexor carpi radialis (61.1 percent). Simultaneous transections of both ulnar and radial arteries occurred in 8.0 percent and both ulnar and median nerves occurred in 15.4 percent. Simultaneous laceration of all four structures i.e., ulnar nerve, ulnar artery, median nerve, and radial artery occurred in 8.6 percent. Patients with one or more lacerated extensor tendons and bones (8 carpal bones, distal radius and ulna) averaged 3.4 each (Table 2).

Figure 10

Table 1: Total Number and Percentage of Injured Structures

Structures	Grade 1 (< 5 structures) (n = 67)	Grade 2 (6 – 9 structures) (n=50)	Grade 3 (> 10 structures) (n = 58)	Total (n = 175)
Tendons				
FCU	30 (44.8)	37 (74.0)	52 (89.6)	119 (68.0)
FCR	16 (23.9)	35 (70.0)	50 (86.3)	101 (57.7)
PL	20 (29.8)	37 (74.0)	50 (86.3)	107 (61.1)
FPL	9 (13.4)	16 (32.0)	48 (82.7)	73 (41.7)
FDS 3	17 (25.4)	27 (54.0)	58 (100.0)	102 (58.3)
FDS 4	17 (25.4)	26 (52.0)	58 (100.0)	101 (57.7)
FDS 2	15 (22.4)	25 (50.0)	56 (96.5)	96 (54.8)
FDS 5	14 (20.9)	35 (70.0)	58 (100.0)	107 (61.1)
FDP 2	8 (11.9)	13 (26.0)	57 (98.3)	78 (44.6)
FDP 3	8 (11.9)	17 (35.4)	57 (98.3)	82 (46.8)
FDP 4	9 (13.4)	20 (40.0)	58 (100.0)	87 (49.7)
FDP 5	9 (13.4)	21 (42.0)	58 (100.0)	88 (50.3)
Nerves				
Ulnar nerve	36 (53.7)	40 (80.0)	52 (89.6)	128 (73.1)
Median nerve	31 (46.3)	31 (62.0)	51 (87.9)	113 (64.6)
Arteries				
Ulnar artery	27 (40.3)	31 (62.0)	50 (86.3)	108 (61.7)
Radial artery	12 (17.9)	8 (16.0)	22 (37.9)	42 (24.0)

FCU, flexor carpi ulnaris; FCR, flexor carpi radials; PL, palmaris longus; FPL, flexor pollicis longus; FDS, flexor digitorum superficialis; FDP, flexor digitorum profundus

Figure 11

Table 2: Total Number and Percentage of Structures Transected Other than Volar Wrist Structures

Structures Transected	Grade 1 (n = 67)	Grade 2 (n = 50)	Grade 3 (n = 58)	Total (n =175)
Extensor tendons	10 (14.9)	16 (32.0)	25 (43.1)	51 (29.1)
Bones	12 (17.9)	15 (30.0)	24 (41.4)	51 (29.1)

Certain patterns of injury correlated with increasing severity of the injury. Spaghetti wrist injuries were classified into grade 1 to 3 with increasing number of volar structure transections with or without associated one or more extensor tendon and bone lacerations (Table 1, 2). The most commonly injured structure in grade 1 (less than five volar structures) was ulnar nerve (53.7 percent), followed by median nerve (46.3 percent) and flexor carpi ulnaris (44.8 percent). The combined ulnar triad structures (flexor carpi ulnaris, ulnar artery and ulnar nerve) were more frequently injured (46.3 percent) than the combined superficial central structures (palmaris longus, median nerve and flexor carpi ulnaris) (33.3 percent) in grade 1 spaghetti wrist. Additionally, this group had 14.9 percent one or more extensor tendon injuries and 17.9 percent one or more bone lacerations. Grade 2 injuries (six to nine volar structures) were almost similar to grade 1 however; there was an increased tendency to involve superficial central structures. The ratio of ulnar to radial artery injuries was greatest (4:1) in grade 2 whereas the frequency of radial artery lacerations was the least (16.0 percent). Furthermore, this group had

32.0 percent one or more extensor tendon and 30.0 percent one or more bone lacerations, which were more than grade 1, indicating increased involvement of these structures in grade 2. Grade 3 injuries (more than 10 volar structures) involved most or all structures of the wrist. The ratio of ulnar artery, ulnar nerve and median nerve injuries were almost 1:1:1. Grade 3 patients were notable for injuries to structures that were least frequently transected, namely, flexor carpi radialis, flexor pollicis longus, and radial artery with frequently injured medial and central structures exceeding 98 percent. Additionally, radial artery was transected in 37.9 percent while 84.5 percent of patients had one or more extensor tendons and bones lacerated.

The data indicates that, the higher the grade of spaghetti wrist laceration, the more likely it was crush/avulsive and infected laceration and less likely treated by primary repair (Table 3, 4). In grade one, sharp lacerations were more frequent (76.2 percent) than in grade 2 (62.0 percent) or grade 3 (53.4 percent). However, crush/avulsive and infected lacerations were less frequent in grade 1 (11.9 percent each) than in grade 2 (20.0 and 18.0 respectively) or grade 3 (27.6 and 19.0 percent respectively) injuries. Highest numbers of structures repaired primarily were for grade1 sharp lacerations (68.7 percent). Delayed primary and secondary repairs were highest for grade 3 crush/avulsive (44.8 percent) and infected (20.7 percent) lacerations.

Figure 12

Table 3: Total number and Percentage of Type of Laceration

Type of Laceration	Grade 1 (n = 67)	Grade 2 (n = 50)	Grade 3 (n = 58)	Total (n = 175)
A1: Sharp	51 (76.2)	31 (62.0)	31 (53.4)	113 (64.6)
A2: Crush/Avulsive	8 (11.9)	10 (20.0)	16 (27.6)	34 (19.4)
A3: Infected	8 (11.9)	9 (18.0)	11 (19.0)	28 (16.0)

Figure 13

Table 4: Total Number and Percentage of Type of Repair

Type of Repair	Grade 1 (n = 67)	Grade 2 (n = 50)	Grade 3 (n = 58)	Total (n = 175)
B1: Primary	46 (68.7)	25 (50.0)	20 (34.5)	91 (52.0)
B2: Delayed primary	13 (19.4)	14 (28.0)	26 (44.8)	53 (30.3)
B3: Secondary	8 (11.9)	11 (22.0)	12 (20.7)	31 (17.7)

DISCUSSION

This study shows that, in recent years there is a definite increase in the frequency of spaghetti wrist injuries among young people. According to Canadian International Development Agency ([7]), Trinidadian society seems to tolerate violence. About 74% of the population lives in urban areas of the country. In urban areas, the economic pressures of the poor, coupled with high youth unemployment, have contributed to growing problems of crime and drug use leading to violent assaults. This problem particularly affects young males suggesting a possible reason for increased frequency of spaghetti wrist injuries. Both Chin et al ([1]) and Kabak et al ([5]) reported, that the most frequent mechanism of injury causing spaghetti wrist injuries were accidental glass lacerations, knife wounds and suicide attempts. In the Trinidadian population, the most frequent mechanism of injury was found to be assault 'cutlass' injury. Other mechanisms include industrial accidents, power saw and gunshot injuries, causing laceration of higher number of structures and crush/avulsive and infective lacerations. These mechanisms of injuries are more likely to involve extensor tendons and bones as evidenced in this study. More than fifty percent of our patients had involvement of one or more extensor tendons and bones (Table 2). Up to fifty percent of our patients were repaired either delayed primarily and secondarily because of the nature of the wound.

Spaghetti wrist lacerations are serious injuries with potentially devastating long-term results. Significant life-long incapacity can occur with severe and crippling sequelae. Despite their relatively frequent occurrence, available data is insufficient in the literature to characterize or to classify these injuries. Hence, at the time of injury and repair of structures, the prognosis, severity of disability, and uniform reporting becomes difficult. If not all, most currently available studies, including functional outcomes studies, described spaghetti wrist as lacerations involving only volar wrist structures and excluded patients who had associated extensor tendon and bone lacerations as well as crush/avulsive and infected lacerations ([1,2,3,4,5]). However, this study shows that the spaghetti wrist injuries are varied involving not just volar wrist structures in numbers, but also often involving one or more extensor tendons and bones. Unlike other studies, crush/avulsive and infected lacerations, especially in severe injuries, are too significant to exclude from the study.

The functional integrity of the hand depends not only on volar structures, but also on extensor tendons, bones and joints, cutaneous nerves and on venous drainage. Extensive volar wrist lacerations can be associated with second-and third-degree sprains, dislocations, and fracture-dislocations, which are likely to develop into various carpal instabilities, such as radiocarpal and perilunate instability, scapholunate, and lunatotriquetral dissociation and distal radio-ulnar joint

disorders ([8]). The nerves and tendons may be repaired in the primary phase of the care, but this is secondary in importance to thorough cleaning and debridement, correct stabilization of fractures and dislocations, and wound closure or coverage with skin grafts or skin flaps ([8]). Depending upon the degree of chondral-surface damage, secondary arthrosis is present to some degree in almost all carpal injuries, which may later lead to deep flexor and extensor tendon damage. Ankylosed wrist in flexion makes satisfactory hand function difficult and is associated with the extent of traumatic arthrosis, the degree and persistence of hemorrhage and edema, the length of immobility, and the position during immobilization ([8])

The minimal definition of spaghetti wrist needs to be redefined comprehensively to include lacerated structures other than volar wrist structures and the classification should include all variants, so that, functional outcome studies can be conducted and reported. We now define the spaghetti wrist as those "extensive volar wrist lacerations occurring between the distal wrist crease and flexor musculotendinous junctions involving a minimum of three completely transected volar structures (nerve, artery and tendon) to at least ten structures, with or without one or more extensor tendons and bones".

Groups ([9], [10]) that have studied isolated nerve injuries have concluded that the primary nerve repair produced improved results over delayed repair and grafting. Others have sought to optimize the results by investigating the relative merits of a fascicular versus an epineural repair, but found no significant differences ([11], [12]). They also found that the return of ulnar motor function was poorer than it was for median nerve. In our study, most patients with crush/avulsive and infected lacerations underwent delayed primary and secondary nerve repair or grafting and furthermore, grade 3 injuries had both ulnar and median nerve injuries, are thus expected to have fair to poor prognosis corroborating the findings in the literature ([2],[3],[4]). Median nerve injuries produced less functional disability, because many patients with isolated injuries can oppose their thumbs reasonably well using the ulnar- or dual-innervated muscles ([3]). In ulnar nerve injuries, intrinsic muscle function, if it returns, could take as long as 5 to 6 years to appear ([3]). Reports of sensory return varied in the literature. Puckett and Meyer ([2]) and Widegerow ([3]) reported, moving two point discrimination was less than 12mm in almost 70 percent of patients, whereas Hudson and deJager ([4]) noted return of two point discrimination in 40 percent of patients (median nerve in 48

percent, ulnar nerve in 38 percent) and Rogers et al ([13]) reported uniformly poor recovery of two-point discrimination. Based on these studies ([2],[3],[4],[13]) our grade 1 patients who had primary nerve repair should have uniformly better sensory recovery than grade 2 and grade 3 patients.

Controversy exists as to the best management of injuries to the radial or ulnar arteries in the forearm and wrist ([6]). Alone or in combination, several options are available for the treatment of radial and ulnar arterial injuries. If an injury involves only one artery in a young person without nerve injury and the intact artery providing adequate circulation, ligation remains a satisfactory option ([6]). In both younger and older patients with inadequate circulation through the intact artery, especially if a nerve injury is present, repair of the injured artery is preferable ([6]). If both arteries are transected, repair of both arteries should be performed, especially in older patients and in patients with concomitant nerve injury ([6]). Gelberman et al found that unrepaired single artery injuries resulted in insignificant changes in hand circulation, but combined arterial and nerve injury resulted in disabling symptoms of pain and cold intolerance ([14]). In our study, after hand ischemia was ruled out, most single arterial injuries were treated by ligation whereas in combined ulnar and radial arterial injuries, both were repaired.

Kabak et al ([5]) analyzed the responses given by 21 patients to the DASH (Disabilities of the Arm, Shoulder and Hand) questionnaire. In this report, only sharp lacerations involving 10 or more volar structures were included, whereas patients with crushing or avulsive injuries and associated fractures were excluded. When both the nerves and /or arteries were cut, the DASH score was generally high. On the other hand, when one artery and /or one nerve was cut, the DASH score was low points. The patients who were clinically evaluated as successful obtained lower scores, whereas those clinically evaluated as poor obtained higher DASH scores.

Based on our experience and review of current literature we propose a classification for spaghetti wrist injuries as shown in table 5. It is important to include all categories of spaghetti wrist in a classification so that no case is excluded from the functional outcomes study. Using this classification, we hope to achieve a uniform reporting, treatment protocol and better prognosis for our patients.

Figure 14

Table 5: Classification of Spaghetti Wrist

		Grade 1	Grade 2	Grade 3
Lacerated Structures	No. Volar structures	≤ 5	6 – 9	≥ 10
	Nerve*	Ulnar or Median	Ulnar and/or Median	Ulnar and/or Median
	Artery**	Ulnar or Radial	Ulnar and/or Radial	Ulnar and/or Radial
	Flexor tendons	≤ 3	4 to 7	≥ 8
	Extensor tendons***	- or +	- or +	- or +
	Bones***	- or +	- or +	- or +
Type of Laceration	A1: Sharp A2: Crush/avulsive A3: Infected	A1 A2 A3	A1 A2 A3	A1 A2 A3
Type of Repair****	B1: Primary B2: Delayed primary B3: Secondary	B1 B2 B3	B1 B2 B3	B1 B2 B3

*also specify laceration of cutaneous nerves; **also specify laceration of major veins; ***specify number of tendons and bones; ****specify timing of repair of each structure

ACKNOWLEDGEMENTS

References

1. Chin G, Weinzweig N, Mead M, Gonzalez M. "Spaghetti Wrist": Management and Results. Plast Reconstr Surg 1998; 102(1): 96-102.

2. Puckett CL, Meyer VH. Results of treatment of extensive volar wrist lacerations: The spaghetti wrist. Plast Reconstr Surg 1985; 75: 714-21.

3. Widgerow AD. Full-house/spaghetti wrist injuries. S Afr J Surg 1990; 28: 6-10.

4. Hudson DA, deJager LT. The spaghetti wrist: Simultaneous laceration of the median and ulnar nerves with flexor tendons at the wrist. J Hand Surg 1993; 18B: 171-3.

5. Kabak S, Halici M, Baktir, Turk CY, Avsarogullari L. Results of treatment of the extensive volar wrist lacerations: 'the spaghetti wrist'. Eur J Emer Med 2002; 9: 71-76.

6. Wright II PE. Acute hand injuries. In: Canale T, ed. Campbell's Operative Orthopedics.9th ed; vol 4: Mosby-Year Book, Inc, St. Louis, Missouri 1998: 3294-3317.

7. Whelan S. Canadian International Development Agency, Gender profile: Trinidad and Tobago 2002.

8. Cooney III WP, Linscheid RL, Dobyns JH. Fractures and dislocations of the wrist. In: Rockwood CA Jr., Green DP, Bucholtz RW, Heckman JD, ed. Rockwood and Green's Fractures in Adults. 4th ed; vol 1: Lippincott-Raven Publishers, Philadelphia, PA 1996:745-867.

9. Grabb WC. Median and ulnar nerve suture: An experimental study comparing primary and secondary repair in monkeys. J Bone Joint Surg 1968; 50A: 964-72.

10. Birch R, Raji ARM. Repair of median and ulnar nerve: Primary suture is best. J Bone Joint Surg 1991:73B:154-7.

11. Young L, Wray RC, Weeks PM. Randomized prospective comparison of fascicular and epineural digital nerve repairs. Plast Reconstr Surg 1981; 68(1):89-93.

12. Orgel MG. Epineurial versus perineurial repair of peripheral nerves (Review). Clin Plast Surg 1984; 11(1):101-4.

13. Rogers GD, Henshall AL, Sach RP, Wallis KA. Simultaneous laceration of the median and ulnar nerves with flexor tendons at the wrist. J Hand Surg 1990; 15A(6):990-5.

14. Gelberman RH, Nunley JA, Koman LA, et al. The results of radial and ulnar arterial repair in the forearm. J Bone Joint Surg 1982; 64A(3): 383-7.

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