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ACCURACY OF PHYSICAL EXAMINATION IN GLASS LACERATIONS TO HAND AND WRIST

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ABSTRACT:

Objective & Background : Hand injuries are one of the commonest injuries seen in Accident and Emergency department and effect mostly the people of working age group. Glass injuries account for around 40% of missed injuries in hand and wrist. Thus accurate diagnosis and subsequent management of such injuries is important in order to avoid morbidity, time off work and financial impact on the community. This study investigates the diagnostic accuracy of pre operative examination of glass laceration to hand and wrist undergoing surgical exploration.

Methods: Between July 2007 to October 2008, 44 consecutive patients with 58 lacerations presenting with glass injury to hand and wrist within 24 hours of injury were included in this prospective study.

Results: Intra operatively, arteries were found lacerated 21 times however pre operative examination could detect injury only 14 times. Similarly, 33 nerves were found injured intra operatively while preoperative examination was able to detect only 27. Intra operatively, 158 tendons were found lacerated. Preoperative examination could detect injury to 107 tendons. This difference was statistically significant for arteries, nerves and tendons with p value less than 0.001 for each of them.

Conclusion: Incidence of missed injuries in glass lacerations to hand and wrist is high. Although clinical examination gives an idea of what structures are injured, it significantly underestimates the true extent of injury. Hence, formal exploration should be considered when glass is implicated as a cause of injury.

Key words: glass laceration, physical examination, wound exploration.

INTRODUCTION:

A large proportion of patients present to emergency department with hand and wrist injuries accounting to 10-20% of total number of injuries presenting to Accident and Emergency department[1]. Most of these patients are young[2] and injury may have a serious impact on their future life[3]. Generally, cutting injuries are usually the main cause of hand injuries[2,3]. The most involved instruments reported in the literature are the knife, followed by glass[4,5]. Glass injuries account for 40% of missed injuries in hand and wrist[6] while another study concludes that subclinical injuries occur in nearly half of the lacerations of forearm and hand when the wound extends the subcutaneous tissue[7]. Thus accurate diagnosis and subsequent management of such injuries is important in order to avoid morbidity, loss of function and sick leave[8]. However, the preoperative examination, even when specifically evaluating for deficiencies, significantly underestimates the extent of damage. Intra operatively, more structures are found lacerated than appreciated by the preoperative physical examination[9]. This study aims to determine the accuracy of the preoperative physical examination of hand and wrist lacerations compared with the

actual findings in the operating room. This would help us to be more cautious and careful in examining hands with glass lacerations. Although some textbooks recommend formal exploration of every glass laceration in operation theatre however evidence to this approach is limited and this paper aims to approve or disapprove this assumption.

MATERIAL AND METHODS:

Between July 2007 to October 2008, 44 consecutive patients with glass laceration to hand or wrist were included in this prospective study. Patients who underwent surgical exploration within 24 hours of injury were included in the study after informed consent. Patients who presented after 24 hours, or were anxious for physical examination or who were less than 6 years of age or had injury not secondary to glass were excluded. All these patients were examined preoperatively by a Plastic surgeon. Age, sex, mechanism of injury, hand dominance, site of injury, zone of injury was documented. Major vessels in case of zone V, i.e. radial and ulnar arteries were examined by finger palpation and where indicated Allen's test was used. All the nerves were checked by light touch at specified anatomical sites. Finally individual tendon was tested, starting with tendons of wrist actively against gravity and against resistance, then with flexor tendons of fingers, then extensor tendons of fingers, and finally tendons of thumb. Loss of movement of individual tendon as well as painful movement was considered as criteria for labelling tendon laceration. All patients underwent surgical exploration in general anaesthesia in tourniquet control and in supine position During surgery, all structures were looked for and documented. All above mentioned variables were documented in a proforma. SPSS v 14.0 was used to analyze data. Descriptive statistics, frequency, percentage were computed for qualitative response variables included in this study. Mean and Standard Deviation were computed for age, hospital stay. Preoperative and intra operative tendon, nerve and artery involvement was compared using a Chi square test. P value of 0.05 or less for tendon, nerve and vessel was considered significant.

RESULTS:

Forty four consecutive patients with 58 lacerations presenting with glass injury to hand and wrist were included in the study. Mean age was 27.1 years with range 7 to 53 years. There were 35 men (79.5%) and 9 women (20.5%). Size of laceration was 1-8 cm with mean of 3.34 cm. Mean hospital stay was 2.2 days ranging from 1 to 4 days. Most of the injuries were accidental (86.4%) with only 13.6% self inflicted. Majority occurred at home (70.5%) followed by workplace (25%) and while travelling (4.5%). Majority (95.5%) were right handed while 4.5% were left handed. However, only 68.2% had their right hand affected, 29.5% left hands and 2.3% in both hands. 72% had single laceration, 23% had two lacerations while 5% had three or more lacerations. Most of the lacerations were in volar zone 5 followed by dorsal zone 8.

Intra operatively, arteries were found lacerated 21 times in Zone 5 with ulnar artery lacerated 14 times while radial artery only 7 times. However, pre operative examination could detect injury to ulnar artery 7 times and radial artery 5 times with total number of detections 14 against actually lacerated 21. Chi-square test applied on individual artery yielded a p value less than 0.001. (Table 1).

Thirty three nerves were found injured intra operatively while preoperative examination was able to detect only 27. Median nerve was the most commonly injured nerve (n=11) followed by ulnar nerve (n=10) and digital nerve of ulnar side of fingers (n=4). The most common nerve that could not be detected accurately preoperatively was the median nerve. Again for nerves, p value was less than 0.001 (Table 1).

Intra operatively 158 tendons were found lacerated. Preoperative examination could detect injury to 107 tendons (Table 2). P value was again less than 0.001.

Flexor digitorum superficialis (FDS) was the most commonly lacerated tendon among all tendons. It was found lacerated 46 times intra operatively, however pre operative examination could detect its injury only 38 times. FDS of index and middle were found more commonly lacerated, however it was of index finger that was not detected the most pre operatively by physical examination.

Flexor digitorum profundus (FDP) was found lacerated 38 times and was detected by pre operative examination 25 times. Middle

TABLE 1:
COMPARISON OF PREOPERATIVE EXAMINATION AND INTRA OPERATIVE FINDINGS IN CASE OF ARTERIES AND NERVES

Arteries	Pre operative examination	Intra operative findings
Total no.	14	21
Ulnar artery	9	14
Radial artery	5	7
Nerves		
Total no.	27	33
Ulnar	11	10
Median	5	11
Radial	2	3
Common digital nerve	3	4
Proper digital nerve ulnar side	5	4
Proper digital nerve radial side	1	1

TABLE 2:
COMPARISON OF PREOPERATIVE EXAMINATION AND INTRA OPERATIVE FINDINGS IN CASE OF TENDONS

Tendons	Pre operative examination	Intra operative
FDS	38	46
FDP	25	38
FCR	5	10
FCU	12	17
PL	7	11
ECRL	2	3
ECRB	1	3
ECU	0	1
ED	7	14
EI	0	1
EDM	4	5
FPL	3	3
APL	1	3
EPL	1	2
EPB	1	4

TABLE 3:
COMPARISON OF RESULTS WITH OTHER STUDIES

Studies	Total no. of lacerations	% of correctly diagnosed nerves	% of correctly diagnosed tendons
Patel J et al[12]	102 (only 14 of zone 5) lacerations of all etiologies	68/72= 94%	102/121= 84%
Nassab R et al[10]	101 Lacerations of all etiologies	78.8 %	68.2 % (Total no. = 22)
Provencher MT et al[9]	34 (all glass)	18/32= 56.24 %	43/103= 41.74 %
This study	58 (27 of zone 5)	27/33= 81.11 %	107/158= 67 %

FIGURE 1:
NERVE INJURIES BY ZONE OF INJURY

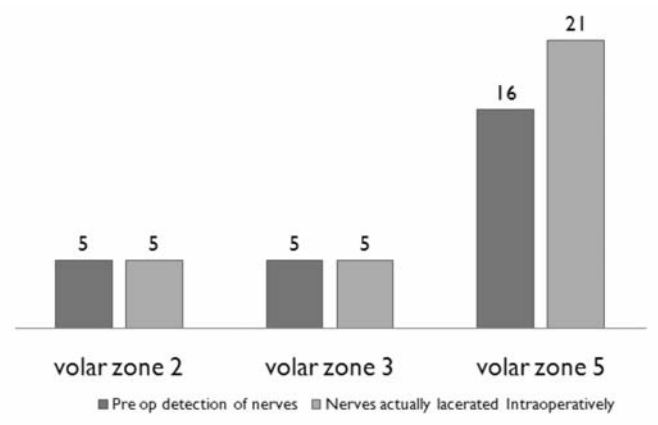
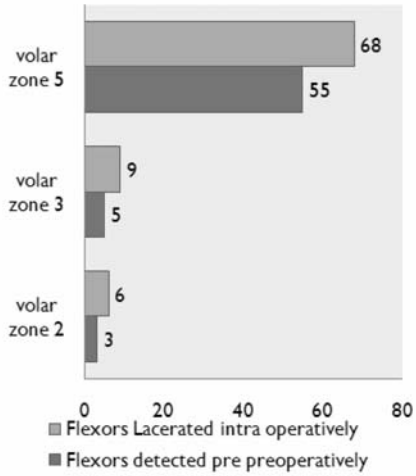


FIGURE 2:
FLEXOR TENDONS BY ZONE OF INJURY



and little fingers' FDP were lacerated most of the times while FDP of index and middle missed most frequently.

Pre operative examination could detect injury to 11 out of 20 actually lacerated long extensor tendons of finger, with extensor digitorum to ring the most commonly missed tendon i.e 3 out of 5 times.

Twelve tendons of thumb were found lacerated during exploration of wounds while they were detected 6 times preoperatively. Most commonly missed tendon was Extensor pollicis brevis which was detected only once while it was found lacerated 4 times actually. Tendons lacerated 50 percent or more of their circumference were 149 in no. and considered substantial injury. One hundred and seven tendons were detected by physical examination and Chi square yielded a p value < 0.001 when physical examination and intra operative examination were cross tabulated.

Only 16 out of 58 examinations were coinciding with actual intra operative findings i.e 27.5 % out of which 15 lacerations had no structures lacerated at all. There were 5 lacerations (5/58=8.6%) in which preoperative physical examination was thought to be normal but wound exploration revealed structures found to be lacerated.

Impact of zone of injury in detecting lacerated structures preoperatively was also studied. Five nerves were found lacerated in Zone II and all were detected preoperatively. Similarly 5 nerves found lacerated in Zone III were detected preoperatively as lacerated. However, out of 21 lacerated nerves in Zone V only 16 were detected as injured preoperatively (figure 1).

Flexor tendons were missed in all zones. Only 3 were detected preoperatively out of actually lacerated 6 tendons in zone II, 5 out of 9 in zone III, and 55 out of 68 in zone V (figure 2). In case of extensor tendons, preoperative physical examination was able to detect 1 out of 3 tendons in dorsal zone II, 0 out of 5 in zone V, 12 out of 14 in zone VI and 2 out of 5 in dorsal zone VIII.

DISCUSSION:

Mechanism of injury has different implications on extent of injury. Deep structures may not be as severely damaged in blunt injuries as compared to sharp penetrating injuries. The size of wound on skin may be small but the damage it causes to underlying tendons, nerves and vessels in highly significant in glass lacerations. So size of wound can be misleading and is not of much significance.

Various reports have shown that there is significant incidence of under diagnosis while assessing glass lacerations to hand and wrist. These injuries are diagnosed when wounds are explored in operating theatres[10].

Injuries may be missed when examination cannot be performed because patient is not fully conscious because of drug abuse or alcohol intoxication. Similarly emotionally upset, very young and patients in pain also fail to cooperate for comprehensive physical examination. Hence these patients were excluded from our study. Another important cause is failure to perform systematic examination. Junior ER doctors may miss injuries because of inexperience and lack of knowledge of anatomical and functional features of hand. However, Gibson TW et al[11] concluded by doing a retrospective and then prospective study that physical examination errors are not well correlated with the level of experience of examiner but with the structures that are injured. Provencher et al[9] further confirmed that preoperative examination underestimates actual extent of damage in glass lacerations to hand and wrist even when performed by trained orthopedic hand surgeon. Peripheral nerve injuries are difficult to diagnose immediately after injury. Lynch and Quinlan[12] confirmed that a nerve impulse can jump a transaction gap up to 72 hours until Wallerian degeneration occurs. This has clinical implication that if a nerve transected but in anatomical contact, is examined within 72 hours, it may appear clinically normal as it will be transmitting impulses. We could detect 27 nerves (81%) preoperatively out of 33 found transected during wound exploration in theatres. This is comparable to other studies (table 4) demonstrating the above mentioned phenomenon.

Only 67% (107/158) of tendons could be detected lacerated preoperatively. This is again comparable to other studies (table 3). Partial tendon lacerations are particularly difficult to diagnose as motor function is present and examiner relies on subjective sensation of pain during passive and active movement. In our study, tendons lacerated 50% or more of their circumference were considered substantial i.e needing repair. So preoperative examination could detect 71% (107 out of actually lacerated 149) of substantial tendon lacerations again under estimating actual damage.

CONCLUSION:

This study concludes that number of lacerated structures is under estimated, so a high index of suspicion is important when examining patients with glass lacerations to hand and wrist. There should be a low threshold for surgery and wounds should be explored properly in operating theatres. Although examination gives a general idea of what has been lacerated, but surgeon should always expect more structures found to be lacerated during wound exploration.

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