

ORIGINAL ARTICLE

HUMAN BITES OF THE HAND: THE TASMANIAN EXPERIENCE

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Introduction: The purpose of the present paper is to provide geographically representative information on the presentation, treatment and complications of human bites of the hand in Australia.

Methods: A 5-year retrospective study was undertaken of patients treated at Royal Hobart Hospital for human bites of the hand. The variables evaluated included age, sex, hand involvement, anatomical distribution, presentation, operative findings, bacteriology, antibiotic use, X-ray findings, complications and compliance.

Results: Thirty-five patients had human bites to the hand. All were male with a median age of 24 years. Most were clenched fist injuries with the middle metacarpophalangeal joint being the most prone to injury. Patients presenting early had a high incidence of open joints and fractures but spent less time in hospital than late presenters, almost all who had infection complications. Compliance with treatment was found to be a major problem. Serious hand infections were not observed.

Conclusion: The treatment of human bites must be early, correct and comprehensive. The appropriate treatment is surgical exploration with debridement and lavage, appropriate antibiotic administration, hand elevation and initial immobilization. Poor compliance of patients in the present study was demonstrated by a high incidence of late presentation, self-discharge from hospital and loss to follow up, making assessment of outcomes difficult. Despite this there is an absence of serious hand infections reported in the literature and this may be due to the administration of antibiotics prior to referral.

Key words: chondral divot fracture, clenched fist injury, fite-bite, hand infections, human bite.

INTRODUCTION

Human bites are relatively common injuries, constituting somewhere between 3.6% and 23% of bites seen by a United States urban physician,¹ the prevalence varying from place to place. Those involving the hand are reputed to be very serious injuries due to their predisposition to infection and their difficulties in treatment. Clenched-fist injuries, received on striking someone's teeth with a closed fist, are particularly dangerous not only because traumatic complications often occur, but also because the mechanism of injury results in the infection being sealed in the deep tissues of the hand so that the injury is often overlooked by both patient and doctor.

If these injuries are not treated promptly, complications including joint stiffness and chronic infection may ensue. The aim of the present study was to determine the occurrence of human bites of the hand at Royal Hobart Hospital (the main referral hospital in Tasmania), Australia, and to understand the types of patients and injuries that present after certain periods of time. The treatment practices at Royal Hobart Hospital and the results of treatment were also investigated.

METHODS

The medical records of 35 patients with human bite injuries to the hand who were admitted to Royal Hobart Hospital, Hobart, Tasmania between 1984 and 1999 were retrospectively analysed.

Obtaining records was limited by the coding system used by the hospital, and the difficult nature of the diagnosis. The records

used in the present study were coded as human bites, cellulitis (hand) or injuries resulting from unarmed fights/brawls. This may have influenced the sample of patients used.

The following variables were evaluated: age, sex, hand involvement, anatomic distribution of injury, clinical presentation, operative findings in patients requiring surgery, bacteriological cultures, antibiotic use, X-ray findings, complications and follow-up compliance.

Patients were divided into two groups depending on the time taken to present to hospital: early (presenting within 2 days of the injury); or late (at any time after 2 days).

RESULTS

Thirty-five patients sustained human bites to the hand. All of these injuries occurred in men and the age range was found to be 12–59 years (median age: 24 years). All but two of the injuries were clenched fist injuries (CFI). The remainder were incisor bites to the finger; one occurred during a fight, the other occurred when a father tried to control the tongue of his fitting son.

The right hand was involved in 60% of cases and the left hand was involved in 40% of cases. Hand dominance could not be assessed. Distribution of the injuries can be seen in Fig. 1. Most injuries were situated over joints, but in one patient the laceration was located in the web space between the fourth and fifth metacarpophalangeal joint, and in another the laceration was in the centre of the dorsum of the hand. Injuries to the metacarpophalangeal and proximal interphalangeal joints were caused by punches, but the two injuries to the distal interphalangeal joints were due to incisor bites.

Time between injury and presentation to hospital ranged from less than 6 h to 19 days, mean 4 days. Seventeen patients presented early (< 2 days) and 18 presented late (more than 2 days).

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Fifteen patients had already been commenced on oral antibiotics at presentation. Two patients were early presenters and 13 were late presenters.

Initial treatment in all groups consisted of irrigation and exploration of the wound, and rest, elevation and splinting. All received antibiotics. Tetanus prophylaxis was given if immunity was not current.

X-ray films

Twenty-three patients (68%) had X-ray films taken. There were no abnormalities detected on 18 of these films, other than soft-tissue swelling. On two films tiny chip fractures of the metacarpal head were seen, and fractures of the head of the metacarpal were seen on another two films. One film had features of septic arthritis.

Microbiological cultures

Twenty cultures from 18 patients were sent for microbiological testing. Four of these showed no growth. One culture grew one type of organism, nine cultures grew two organisms, three cultures grew three types of organism, and one culture grew four types of organisms. Two cultures grew normal skin flora.

Streptococci were most commonly isolated (*Streptococcus viridans* (n = 9); *Staphylococcus pyogenes* (n = 2) and others (n = 2)). *Staphylococcus aureus* (n = 4) and coagulase-negative staphylococcus (n = 7) were also common isolates. Anaerobes (n = 3), diptheroids (n = 2) and *Haemophilus* (n = 1) were less common. There were no isolates of *Eikenella corrodens*, even though this organism was sought on culture.

Antibiotics

All patients received antibiotics. These were administered intravenously in 32 cases; oral antibiotics were given to three patients. The intravenous antibiotics given most often were combinations of penicillin, flucloxicillin and metronidazole. Other combinations involved gentamicin and cephalosporins.

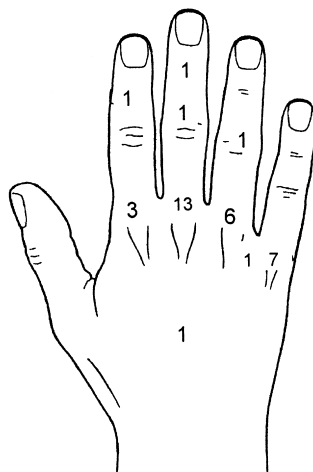


Fig. 1. Distribution of skin lacerations.

Surgical findings

Twenty-one patients had surgery; three of these required two operations. All operations included exploration, debridement and lavage. The solution used for lavage was saline only in 53% of cases; hydrogen peroxide and saline in 33% of cases; and gentamicin and saline in 13% cases. Five operations included repair of the extensor tendon and/or the joint capsule and one involved inserting a k-wire.

Primary closure was carried out in two cases; neither had signs of infection. Two cases required delayed primary/secondary repair. The other wounds were not closed and were left to heal by secondary intention, or closed loosely with a drain or betadine wick inserted. One patient required a skin graft to repair the wound.

Hospitalization

Only three patients in the present series were not admitted to hospital. Patients stayed for between one and 12 nights (mean: four nights). One patient required readmission after being discharged due to a recurrent infection in the wound. Four patients discharged themselves against advice after stays in hospital for 1, 2, 3 and 5 nights. The lowest mean hospital stay was observed in the 'early' group (Table 1).

Complications

Twenty-five patients presented with cellulitis, 12 patients suffered extensor tendon damage, and 13 patients were found to have open joints, of which four were diagnosed as being septic. Bone complications were limited to the fractures mentioned in X-ray findings (Table 2).

Follow up

Of the 35 patients in the present series, five were followed at other hospitals; one patient is continuing to present for follow up; 22 (63%) patients were lost before follow up was completed; and seven (20%) continued to present for follow up until

Table 1. Mean hospitalization times and results for early and late presenters

	Early presenters (n = 17)	Late presenters (n = 18)
Hospital stay (mean days)	3, 2	4, 3
Full range of movement	30%	11%
Percentage lost to follow up	59%	67%

Table 2. Complications for early and late presenters

Complication	Early presentation (n = 17)	Late presentation (n = 18)
Tendon (%)	24	35
Open joint (%)	53	35
Fracture (%)	30	11
Cellulitis (%)	53	95

discharged. Non-compliance with follow up instructions was common in this series. Eleven (31%) patients failed to attend any follow up. Eleven patients attended the clinic only once or twice until the wound had healed, thus the functional results are not known.

Of the seven patients who completed follow up, five achieved a full range of motion but one went on to develop complex regional pain syndrome. The other two patients achieved a reasonable range of motion and were discharged. Of the patients followed up at Royal Hobart Hospital, 59% of the early group and 67% of the late group were lost.

LITERATURE REVIEW

Human bites have been recorded since 1910 when Hultgen reported a case of 'gangrenous paronychia' in a girl of age seven with a habit of biting her nails.² Peters (1911) reported the first cases of clenched fist injury in which he described intense swelling and a foul discharge from the wounds.³ Early treatment was dependent on surgical debridement and lavage but other methods consisted of electrocautery⁴ and irrigation with 'fuming' nitric acid.⁵

The treatment today is still primarily surgical, and adequate debridement and lavage are vital, as well as elevation and immobilization using splints and bulky dressings. The wound should be left open to heal by secondary intention^{6,7} to prevent severe infectious complications. The advent of antibiotic use, particularly the use of parenteral antibiotics, has also improved the results of clenched fist injuries dramatically.

Despite the improvements the clenched fist human bite injury is still said to be one of the most serious injuries to the hand. This is because the clenched fist injury is obtained when the metacarpophalangeal joints are flexed and the skin is held taught over the joint, providing little protection for the tendon or joint capsule. When the fist is opened the tendon retracts proximally, concealing the actual depth of the penetration and this is often not recognized by the patient or the physician. This mechanism also results in the inoculation of bacteria being sealed within the deep structures of the hand and will predispose to severe infections (often involving anaerobic organisms) such as septic arthritis and deep-space abscesses. It has been reported that in bites of the hand, infection rates may be as high as 17%.¹

Complications of human bite wounds of the hand consist of those due to infections and those that are the result of the traumatic injury. It has been recognized that the most important factor in the development of complications of human bite wounds of the hand is the lapsed time between injury and initial treatment. Maier first reported this in 1937⁸ and recent research is in general agreement on this matter. Treatment must be 'early, correct and comprehensive'⁹ in order for the patients to achieve a full and fast recovery.

It is important to ask about human bite injuries when a patient presents with a wound involving their metacarpophalangeal joints. It is difficult to know how many patients do not admit to the cause of their injury in a retrospective study such as this, but figures in the literature suggest that up to one-third of patients may give an alternate explanation at first for their injury. Because of the seriousness of the injury and the need for early treatment, it is important that all wounds on the dorsum of the metacarpophalangeal joints are viewed with suspicion.

In the classical study of 1930, Mason and Koch elegantly illustrated the anatomical basis for spread of infection from a

clenched fist injury.¹⁰ The first stage after the initial inoculation of bacteria is subcutaneous spread, and then a subaponeurotic abscess may develop. The infection may proceed to the bone (osteomyelitis) or into the volar aspect of the hand to be associated with the lumbrical muscles and the flexor tendons (tenosynovitis). The last stage of spread of infection in the hand is when a mid-palmar space infection develops.

Osteomyelitis and tenosynovitis are dangerous complications of human bite injuries because they are extremely difficult to eradicate. Tenosynovitis is associated with a risk of both amputation and permanent joint stiffness. Mennen and Howells found that three-fourths of their patients who developed osteomyelitis required amputation.⁹

Traumatic complications are relatively unavoidable. These include extensor tendon division, laceration of the joint capsule, fractures of the metacarpal head and 'chondral divot fractures' of the articular surface. It has been found that when the force of impact has been sufficient to damage the tendon, the joint capsule and articular surfaces are likely to be lacerated.⁶

'Chondral divot fractures' are so termed because they result from a tooth striking the articular surface of the joint and causing fragments of articular cartilage, with or without bone, to be chipped off. The incidence of these fractures has been found to be 5.8%¹¹ and 30.4%¹² in retrospective studies and 58.6% in a prospective study.⁶ In the present study it was found that the incidence of tendon damage was 34% and bone and cartilage chips were noted at surgery in 13%.

Microbiological studies of human bite wounds have been performed since the first cases of infection from bites were noticed. The organisms most commonly involved in human bite infections are combinations of skin and the oral flora. Early studies from the 1920s and 1930s isolated the organisms of Vincent's angina,^{3,13} these being the spirochaete *Borrelia* and the anaerobic bacterium *Fusobacterium* which acted synergistically to produce a gangrenous infection. Maier found it to be the most frequent cause of infection in his series.⁹ Bates⁴ and Welch¹⁴ found *Streptococcus viridans* and *Staphylococcus aureus* in their cultures, and Guba *et al.* noted that staphylococcal infection was associated with a worse clinical outcome.¹⁵

Recent findings confirmed that *Streptococcus* spp. and *Staphylococcus* spp. are the most frequent organisms¹⁶ but, as better laboratory methods have developed, more anaerobic organisms such as *Bacteroides* have been isolated. Gram-negative organisms have also been found in human bite wounds but usually only in mixed infections. These include diptheroids (*Corynebacterium* spp.), *Haemophilus* and coliforms.

Only 51% of cases in the present series underwent microbiological testing. Of these cases, though, the organisms isolated were in fitting with past literature.¹⁵ The most commonly isolated organisms were *Streptococcus* spp., then *Staphylococcus* spp. followed by anaerobes and Gram-negative rods.

A recent development in human bite wounds has been the finding of *Eikenella corrodens*, a Gram-negative facultative anaerobic rod, that is thought to act synergistically with Gram-positive and anaerobic bacteria.^{17,18} It is thought that it may exist in 6–30% of human bite infections, but there is no evidence to suggest that infections involving *Eikenella corrodens* are more serious than other infections.

As discussed, the infectious complications of human bites of the hand are the main causes for the severe morbidity associated with these injuries. Before the introduction of antibiotics there were occasional deaths attributable to severe human bite infections.

As antibiotics were introduced, penicillin was found to improve the outcome of clenched fist injuries, but the importance of surgical debridement was emphasized.¹⁹ Currently, because *Staphylococcus* has become penicillin-resistant and anaerobes and Gram-negative organisms are frequently isolated from human bite infections, physicians are advised to use broad-spectrum antibiotics and antibiotic combinations.¹⁵

These combinations often include a drug that will target Gram-negative organisms such as gentamicin, and a penicillinase-resistant penicillin, such as cloxacillin or flucloxacillin for *Staphylococcus*. Combinations using penicillin for *Streptococcus* and metronidazole to target anaerobes are also used. Broad-spectrum antibiotics such as cephalosporins are also used, and are probably more widely advised in the literature.

The use of intravenous antibiotics is suggested for moderate to severe infections because of the relatively low vascularity of tendons, joint and other connective tissues. Oral antibiotics have been shown to be sufficient in many studies²⁰ for superficially infected or uninfected wounds.

The *Australian Therapeutic Guidelines* advise the use of intramuscular procaine penicillin (single dose) followed by oral augmentin for uninfected high-risk human bites and metronidazole orally plus cefotaxime or ceftriaxone intravenously for severe and penetrating bites.²¹

DISCUSSION

The characteristics of patients suffering human bite injuries of the hand have been found to be quite consistent despite studies being conducted in a variety of different countries. Most studies have found a predominance of male patients with these wounds, which is probably due to the physically aggressive nature of the injury. The prevalence of female patients in the studies has ranged from 0 to 46%²² but it is usually seen that where the prevalence of female patients is increased, so too is the prevalence of incisor bites of the hands, rather than clenched fist injuries.²² Thus it is fitting that in the present study, in which the bulk of the injuries were of the clenched fist variety, the patients were all male.

Most literature has found that the most common anatomical location of clenched fist injuries is over the 3rd metacarpal-phalangeal joints. This is likely due to this knuckle being the most prominent when the fist is clenched. As with the findings in previous studies, most patients in this series were in their third decade.

An accepted way to subgroup patients with a human bite injury is by Welch's classification into 'early' (< 1 day), 'delayed' (1–7 days) and 'late' (> 7 days) on the basis of time elapsed between injury and presentation to hospital. We chose to use early (< 2 days) and late (> 2 days) because we found that patients presenting in these time frames shared many similarities. Other methods have been used including classifying wounds by their depth and structures involved²³ or their infected status,²² but this was not possible in the present retrospective study due to lack of information in the records.

We found that those patients presenting early had a higher incidence of traumatic complications (open joints and fractures) and this has been the experience of other authors.²² This group also had a low percentage of patients presenting with cellulitis, due to the lack of time for this to develop. Nearly 60% of this group required surgery and most procedures performed were debridement and lavage.

This group achieved the highest percentage of return to full range of motion after the injury, which is probably due to the early treatment to prevent complications, and better compliance.

In a South African study Dreyfuss and Singer suggested that the 'late' group consist of those patients who present only once the pain from the injury is too great to control at home or prevents them from working.²² This pain is often due to infectious sequelae of the initial injury. In the late presenters we found that there was a high prevalence of tendon damage, open joints and cellulitis but fractures were rare. There were no cases of osteomyelitis, tenosynovitis or palmar space infections and no patients required an amputation. This has not been the experience of others^{9,22} and the reason for this is probably due to the patients having been prescribed antibiotics by another doctor prior to referral to us.

Few patients in the 'late' group completed follow up, thus few were known to gain a full range of motion after the injury had healed. The lack of compliance with follow up instructions may indicate that these patients were not compliant with other aspects of their injury care.

Overall there was a lack of serious complications observed by others in other literature. This is probably due to the relatively early presentation to hospital of most patients and the prior use of antibiotics in patients who presented late. Phair and Quinton concluded that the low rate of osteomyelitis (3.4%) in their study was due to the high rate of early surgical debridement.⁶ Gonzalez *et al.* found that the main factors leading to the development of osteomyelitis were delayed initial treatment, inadequate debridement and initial suturing of the wound.²⁴

We found that patients with human bite injuries spent an average of 4 days in hospital. Patients presenting earlier spent less time in hospital. There was a 10% self-discharge rate, the incidence reflecting the problem of compliance in this patient group.

A major problem with the study of human bite injuries, particularly those of the clenched fist variety, is that there are a large number of unreliable patients involved. This is the reason for the late presentation of the injury in many cases, and the cause for so many of the cases being lost to follow up before the functional result was known. It is also an important factor in devising treatment plans for the management of the injuries.

Recent studies have found that, especially in those patients who presented later without signs of infection, outpatient treatment is quite adequate, along with oral antibiotics.^{7,25,26} In fact, Malinowski *et al.* found fewer complications in their non-hospitalized group with uninfected/superficially infected wounds than in the group who was hospitalized⁷ but this may be due to the higher proportion of superficially infected rather than uninfected bites in the hospitalized group. Dreyfuss and Singer outlined two indications for essential patient admission: (i) 'late' presentation and severe complications; and (ii) in the unreliable patient with infection present.²²

In the present study it seems that the most unreliable patients are those who present late: they were found to have the lowest rates of compliance with follow up, and three of the four patients who discharged themselves at their own risk were in this group. This group is also the one that presented with the highest rate of cellulitis (95%); thus we believe we should endeavour to admit all patients presenting after 2 days following injury.

Instilling compliance remains a challenge to the profession when dealing with these injuries.

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