

# Hand Trauma Pitfalls: A Retrospective Study of Fight Bites

Patrick KY Goon<sup>1</sup>, Matti Mahmoud<sup>1</sup>, Vaikunthan Rajaratnam<sup>2</sup>

## Abstract

Clench fist or fight bite injuries are associated with some of the worst types of infective complications but their mechanism is often poorly understood. In a retrospective case series, 34 patients seen between 1998 and 2004 presented to a local hand surgery unit with confirmed human bite hand injuries. Seventy-six percent presented with infective complications with a mean delay in presentation of 4 days. Eighty percent of patients were clenched fist injuries (CFI) (open joints in 59% and tendon injuries in 63%). Using an aggressive treatment policy including early surgical and antibiotic intervention, most patients achieved good results functionally (full range of movement was achieved in 83% of those with CFI which completed follow-up (44%)). High rates of non-compliance and incomplete follow-up was noted. Major long-term complications including limited range of movement and osteomyelitis was low and suggests the policy of prompt and comprehensive surgical and medical intervention is the optimal treatment option. A brief but in-depth discussion of the specific anatomical pitfalls is included.

## Key Words

Fight bites · Punch bites · Clenched fist injury · Human bites · Chondral divot fractures

Eur J Trauma Emerg Surg 2008;34:135–40

DOI 10.1007/s00068-007-6183-9

## Introduction

Human bites are common injuries seen in Accident and Emergency Departments but require special consideration. Presenting in two ways: either as a direct bite usually confined to the limbs, head and neck regions e.g., pinna, or as a result of striking another person in the teeth with a clenched fist. The latter is known as a 'fight bite' or clenched fist injury (CFI). Of the two, fight bites pose a greater problem for the attending physician.

The fight bite often involves deep structures besides the obvious skin laceration, including the metacarpophalangeal joints (MCPJ). The initial trauma may cause fractures, articular cartilage, extensor tendon and ligament damage but it is the ensuing infection (up to 50% [1]) that is responsible for the worse outcomes seen. Infection is typically aggressive with rapid soft tissue destruction and if left unchecked or worse still, undetected by the unwary physician, culminates in disastrous consequences for the patient.

The aim of the present study was to ascertain the success of current treatment practices and identify the potential pitfalls when treating injuries to the hand caused by human bites. We present our findings from a regional hand unit including a pictorial of fight bite mechanisms and a brief look at the current literature.

## Patients and Methods

All patients seen in the emergency department presenting with hand injuries between the years 1998 and 2004 were included in the initial search. Examination

<sup>1</sup>Department of Plastic Surgery, Selly Oak, University Birmingham Hospital, Birmingham, UK,

<sup>2</sup>Department of Trauma and Orthopaedics, Selly Oak, University Birmingham Hospital, Birmingham, UK.

Presented at: 9th World Congress of the International Federation of Societies for the Surgery of the Hand 2004 (IFSSH), June 2004, Budapest, Hungary.

Received: September 21, 2006; revision accepted: June 8, 2007;  
Published Online: October 11, 2007

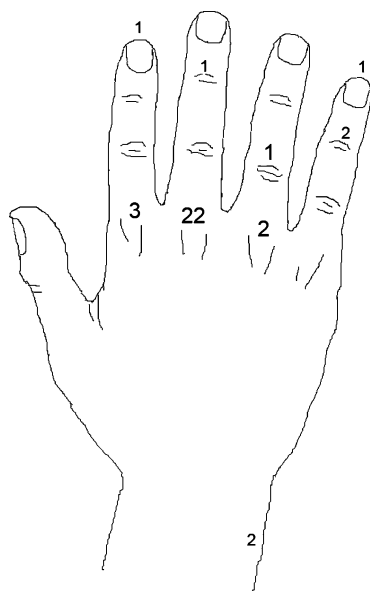


**Figure 1.** Distribution of injuries. (Fight bites are indicated by larger font size compared to occlusion injuries; All injuries depicted on Right hand for clarity).

of individual medical records identified 34 patients with definite human bite injuries. Only those patients with complete medical records were included in the final study.

## Results

### Presentation

Thirty-four patients were included in the final analysis. All presented with hand injuries related to human teeth. Most were young patients (age: 19–38 years; mean 28 years), adult males (87%) and predominantly of lower social class (SC) (11% SC IV, 68% SC V), with social class being a socio-economic classification based upon occupation/employment status (higher SC equates roughly with better employment status) [2]. In this series, most patients were Caucasian (71%), and the rest of Asian (14.5%) or Afro-Caribbean descent (14.5%).

Of the total injuries, 29 involved the right hand (85%) and 5 involved the left (15%). The dominant side was involved in 94%. All cases except 2 were a result of violent intent: 1 case resulted from sexual activity (occlusion) and 1 case resulted from a rugby game collision (accidental CFI). The influence of alcohol was prevalent (92%) with 3 patients (8%) admitting to illicit drug use. The distribution of the injuries is shown in figure 1.

Of the 34 patients, 27 (79%) suffered from CFI, all involving the dominant hand. The injuries were all situated over the MCPJ, with the 2nd, 3rd and 4th

MCPJ most commonly involved (Figure 1). The remaining 7 patients (21%) had occlusion bite injuries. Their pattern of injury was more varied, with sites other than over the MCPJ (Figure 1).

Patients presented anywhere from 5 h to 21 days (average: 4 days) from the time of initial injury, usually the wound had become very inflamed (75%), with other signs of infection including pus and foul smell. Twenty patients presented at 2 days or less, whereas 14 presented after 2 days. 19/27 of CFI cases presented at 2 days or sooner (71%). Only four patients had already commenced on antibiotics (penicillin) at presentation, in all cases less than 48 h. All patients received initial treatment in the form of exploration and irrigation with saline and tetanus prophylaxis. All except 1 patient was admitted for further treatment and started on intravenous antibiotics. The predominant antibiotic regimes were either penicillin, flucloxacillin and metronidazole, or amoxillin/clavulanic acid (Augmentin®) and metronidazole. In two patients, the regime was changed to gentamicin and ticarcillin/clavulanate.

### Radiographic Findings

Thirty patients (88%) had radiographic investigations. Of these, six patients (20%) had radiological abnormalities other than soft tissue swelling. These included 2 films with metacarpal fractures (CFI; non-articular fractures), 1 film with a distal phalanx fracture (occlusive) and 3 demonstrating chip fragments off the metacarpal heads (CFI). All cases with fractures presented early at 2 days or earlier. No films demonstrated septic arthritis.

### Microbiological Analysis

Twenty-seven culture specimens were sent for microbiological culture and sensitivity testing. In the remaining seven cases, the information was lacking. Of those tested, six showed nil growth whilst four cultured two organisms and one cultured three organisms. The commonest organisms isolated were Gram +ve *Staphylococcus aureus* (15%) and *Streptococcus* (52%) species. There was nil growth of *Eikenella corrodens*, despite specific attempts to do so. Summary of findings is shown in table 1.

### Operative Findings

33/34 patients had surgery: including all 27 CFI patients and 6 occlusion bite patients. Average injury to surgery time was 4.37 days, largely due to a delay in presentation. All operations included a preliminary detailed exploration, debridement of contaminated and necrotic tissues, extensive lavage and repair of

**Table 1.** Organisms grown from wound culture specimens. A total of 27 specimens analysed.

| Cultured organisms                         | Number of patients |
|--------------------------------------------|--------------------|
| No results available                       | 7                  |
| No growth                                  | 6                  |
| Normal skin flora                          | 5                  |
| <i>Staphylococcus aureus</i>               | 4                  |
| <i>Streptococcus viridans</i>              | 6                  |
| <i>Streptococcus milleri</i>               | 3                  |
| Beta haemolytic <i>Streptococcus</i> Grp A | 3                  |
| Beta haemolytic <i>Streptococcus</i> Grp C | 1                  |
| Beta haemolytic <i>Streptococcus</i> Grp F | 1                  |
| Anaerobes                                  | 1                  |
| <i>Candida albicans</i>                    | 1                  |
| <i>Neisseria</i>                           | 1                  |
| Coliforms                                  | 1                  |

structures. Eighteen operations (55%) included repair of tendons (17 patients: extensor tendons and/or joint capsule, 1 patient: flexor tendon). Another patient required the insertion of a K-wire for an unstable metacarpal fracture. In only two cases was primary closure carried out, both instances were non-infected occlusional bite wounds without complications. All other wounds were either left open to heal by secondary intention, or were loosely apposed with the presence of a corrugated drain. Three cases required delayed primary repair as a result of needing further debridement and washouts. Two cases underwent repeat operations (drainage of a palmar abscess with decompression in one; delayed secondary repair of tendons in the other).

#### Concomitant Injuries/Findings

Twenty-six patients (76%) presented with cellulitis (remaining eight cases had no overt signs of cellulitis, and all were early presenters i.e., 2 days or less), 18 patients (53%) had tendon damage and 16 patients (47%) had open joints with five cases showing obvious signs of being septic. The findings are summarized in Table 2.

#### Hospitalization and Follow Up

Thirty-three patients were admitted for further treatment, with one patient refusing admission or treatment (occlusional). Time of hospital stay was between 1 day and 2 weeks (average 4 days). Shortest average stay (2 days) was seen in the patient group that presented at 2 days or less from time of injury. One patient required repeated hospitalization over a period of 5 weeks for recurrent infection. Two patients self-discharged

**Table 2.** Findings for fight bites and occlusive bites.

| Complications (%)         | Fight bite (n = 27) | Occlusive bite (n = 7) | Total (n = 34) |
|---------------------------|---------------------|------------------------|----------------|
| Cellulitis                | 85                  | 43                     | 76             |
| Open joint                | 59                  | -                      | 47             |
| Tendon injury             | 63                  | 14                     | 53             |
| Fractures (non-articular) | 7                   | 14                     | 9              |
| Chondral divot fractures  | 11                  | -                      | 9              |
| Osteomyelitis             | 4                   | -                      | 3              |
| Palmar abscess            | 4                   | -                      | 3              |

**Table 3.** Results of follow-up and functional assessment.

|                                     | Fight bite (n = 27) | Occlusive bite (n = 7) | Total (n = 34) |
|-------------------------------------|---------------------|------------------------|----------------|
| Self-discharge (%)                  | 7                   | 14                     | 9              |
| Lost to FU (%)                      | 56                  | 100                    | 56             |
| Complete FU (%)                     | 44                  | -                      | 35             |
| FROM in Complete FU group (%)       | 83                  | -                      | 29             |
| Stiff/pain in Complete FU group (%) | 17                  | -                      | 6              |

FU = Follow Up; FROM = Full Range of Movement.

immediately post-surgery. Of the 33 patients receiving surgery, only 24 patients (73%) returned for follow-up and of these, only 12 patients (36%) continued to attend regular follow-up till discharge. The majority failing to complete follow-up were those with nearly healed wounds at the first clinic attendance (usually 2–5 days post-discharge) and with near to or full range of movement at that point. However, the final functional outcome in these patients could not be ascertained. Of the 12 patients that completed follow-up, 10 achieved full range of motion and another 2 had persisting joint stiffness and pain at the MCPJ level (1 patient had chronic infection; 1 patient required secondary repair of tendons) (Table 3).

#### Discussion

Studies report a consistent demographic pattern in the fight bite patient namely young, male, and involved in acts of aggression [1, 3–14]. Our study confirms this, and illustrates other notable but rare associations including 'sports injury' and 'rough sexual activity'. Other relationships include lower SC, alcohol and illicit drug consumption (4). A significant number of female patients (13%) were included, but contrary to other reports (5), these were all of CFI type. Mean delay in presentation was 4 days, very similar to that reported by Tonta et al. [6]. Interestingly, although the

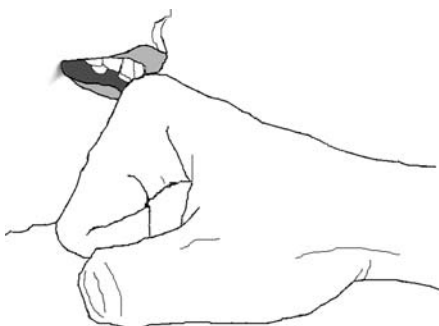


**Figure 2.** Diagrammatic representation of a clenched fist impacting opponent's teeth.

study size was relatively small, particular trends clearly in agreement with others [5, 6] were seen: early presenters were more likely to present with fractures than cellulitis, compared to late presenters, although it is possible that some injuries might have been underestimated.

Commonly reported in conjunction with occlusional bite injuries, fight bite incidence is suggested to vary from 3.6 to 23% of total bites [3]. Another report quotes an incidence of 11.8 per 100,000 population/year in a major city [4]. Under reporting is recognized, with reasons including the quick resolution of a minor injury, embarrassment, fear of hospitals, or fear of legal repercussions [4]. Perhaps up to one third of all patients may relate a spurious history, and unless viewed with a high index of suspicion, the real reasons will elude the practitioner [6]. However so, it is vitally important to obtain reliable information concerning the mode and time of the injury as this directly impacts on the infective complication risk [7].

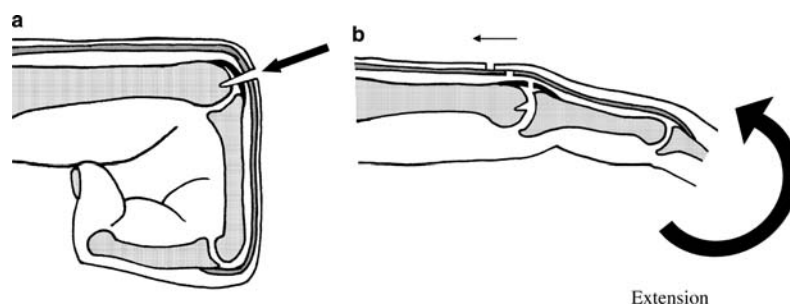
Human bites are particularly problematic for specific reasons. Firstly, patients commonly ignore the wound as they fail to appreciate its severity [4–8]. This results in significant delay. Secondly, the particular wound inoculum (saliva) is characteristically virulent. Human saliva contains a high bacterial load ( $10^8$ /ml) with numerous species of bacteria (potentially > 190 types [9]). Indeed, the risk of hand infection with human bites is well documented; one randomized, prospective study reported an overall increase in infection rate of 47.6% in the placebo as opposed to the antibiotic group [1]. The risk appears ameliorated in low-risk wounds (skin involvement only) [15]. The possibility of virus transmission (e.g., hepatitis viruses A, B, C) must also be considered, although transmission of other virus like HIV is deemed unlikely [14]. A third reason involves the local environment of the wound. This particularly concerns CFI where the tissues involved (e.g., extensor tendon, chondral carti-

lage, MCPJ synovium/capsule) are relatively avascular and also 'sealed off' thus precluding natural drainage of the wound [16]. The joint space and fluid also provides a suitable medium for bacterial growth.

CFI give rise to a distinct anatomy of injury, owing to the mechanism. The patient sustains a puncture laceration over the dorsum of the MCPJ as a result of the clenched fist connecting with the opponent's teeth (Figure 2). The 2nd and 3rd MCPJ joints of the dominant hand are commonly involved, reflected in our findings (Figure 1). The wound is usually small (5 mm) but frequently involves the joint as the capsule is relatively superficial, taut and easily breached in its flexed position. In the course of its journey, the tooth breaches the skin, extensor tendon, joint capsule, articular cartilage and impacts the metacarpal head, in that order. When the fingers are extended, overlying tissues (skin, tendon, capsule) retract proximally, in effect *sealing off* the wound and inoculated joint space [12, 16], the so-called 'trap-door' effect (Figure 3a, b). A unique injury worth mentioning is that seen when the tooth impacts the exposed articular surface of the metacarpal head, only made accessible in its current flexed position when the fist is clenched. This results in a 'chondral divot fracture', so termed because the tooth effectively gouges out a 'divot' in the cartilage, and may also chip the underlying bone. The frequency of such findings varies between studies (5.8–30.4% [17–19] but is subject to the level of reporting by the operating physician. In the present study, we report an incidence of 11% in CFI, bearing in mind that of the 16 open MCP joints, in only 5 cases (31%) was there specific documentation regarding the chondral surface.

The presentation of these wounds can be divided into traumatic and infective, with infection being commonest. Illustrated by the classic work of Mason & Koch [20], infection usually spreads to the subcutaneous and subfascial spaces on the dorsum of the hand. Occasionally, it involves the palmar spaces via the interosseous and lumbrical sheaths and can present with infective tenosynovitis and/or a mid-palmar space abscess and rarely, osteomyelitis [12]. Locally, pus forms within the MCPJ giving rise to septic arthritis, with chondrolysis of articular cartilage and subchondral bone destruction. When tenosynovitis and osteomyelitis is present, the infection is difficult to eradicate and in worst instances, leads to chronic stiffness and even amputation [21]. The incidence of major infective complications was low in this study, possibly reflecting the relatively early presentation time of 4 days, something noted in other studies [6, 17]. Other sequelae include traumatic complications like extensor tendon

**Figures 3a and 3b.** a) Diagrammatic representation of tooth penetrating consecutive tissues (skin, extensor tendon, joint capsule, articular surface, metacarpal head), indicated by *arrow*. b) Diagrammatic representation of 'trap door' phenomenon during extension of fingers resulting in misalignment of soft tissues as they move proximally (*small arrow*) to the joint.



injuries, joint disruption, metacarpal fractures and rarely, digital nerve/artery damage.

Wound bacteriology is commonly polymicrobial [22] and includes skin and oral flora. Aerobes like *Streptococcus*, *Staphylococcus* and *Eikenella* species predominate [22, 23], with anaerobes like *Peptostreptococcus* and *Bacteroides* frequently isolated (52% [22]). Dentition state is also important, with neglected mouths containing mainly anaerobic and proteolytic bacteria whereas mouths with good oral hygiene have mostly aerobes or facultative anaerobes [12]. Rarely, human bites have been known to transmit *Clostridium tetani* [7]. Hence, all patients with suspected human bites should have their tetanus immunity status assessed and tetanus toxoid administered if in doubt.

*Staphylococcus aureus* is associated with the most severe infections whereas the slow-growing, facultative *E. corrodens* is associated with chronic infections and abscesses [10, 12, 14] and is thought to act synergistically with Gram +ve and anaerobic bacteria [24]. Culture of *E. corrodens* and anaerobic bacteria is often difficult as they need optimal conditions to survive. Studies have reported an incidence of up to 30% of *E. corrodens* in CFI [22, 23]; in our study, there was often a significant delay from the time the swabs were taken till they were actually cultured. This might well explain the high percentage of negative cultures and absence of any *E. corrodens* in our samples, also reported by another group [6]. With this in mind, antibiotics should always be instituted despite culture negative results, and should provide sufficient cover for *Staphylococcal*, *Streptococcal* species, *E. corrodens* and anaerobes. In light of the study findings and current literature [23, 25], the antibiotic regime used in our unit is now standardized to amoxicillin/clavulanate plus metronidazole intravenously. For established infections, stronger combinations such as ticarcillin/clavulanate or piperacillin/tazobactam should be considered. Compared to CFI, occlusional bites fare better as the wounds tend to remain open. The predominant organisms are similar to CFI [7–9, 22].

Early debridement and washout together with appropriate antibiotic therapy is currently recommended [1, 5–7, 13, 16–18, 23, 25]. During surgery appropriate skin incisions and extending the wounds to gain sufficient exposure is important. This step must not be compromised for the sake of cosmesis. Next, all internal structures are meticulously inspected in turn. If the injury is over a joint, the capsule must be scrutinized for joint extension. It is mandatory to do this with the joint flexed i.e., the position of impact, which will realign the soft tissues and reveal any laceration of the tendon and capsule etc. Once breached, the joint must be opened and damaged tissue (including wound margins) painstakingly debrided and sent for bacterial culture, keeping in mind that the puncture wounds through the various tissues will not correspond once the joint is extended. Copious irrigation of the wound is essential (minimum of 1 l). In our unit, the preference is for copious, dilute povidone iodine solution as an irrigation fluid, delivered through a 10 ml syringe and needle to achieve a pressure jet. Alternatively, some units use a specific pressurized pump irrigator and wash solutions of dilute hydrogen peroxide.

Traditionally, the wounds are left open to heal by secondary intention as there is a much higher infection risk with primary closure [16, 25, 26]. A newer approach involving vacuum-assisted closure dressings is showing promise in some centres. The practice of delayed closure can also be very effective. Controversially, a recent report suggests primary closure of selected human bite wounds yields comparable results to the traditional approach [27]. In our unit, primary closure is only ever used if the wounds are occlusive bites, not involving a joint and clinically non-infected. After surgery, it is good practice to elevate and mobilize the hand early, with physiotherapy supervision [12, 16]. We suggest that this is a key factor in determining final functional outcome.

Outcome is dependent on multiple factors, the most important being time of delay, inadequate debridement of wounds and suturing of wounds pri-

marily [26, 28]. Other factors include treatment compliance and antibiotic use. In our series, taking into account the high drop-out rate for follow-up (56% in CFI), final functional outcome was good in those that completed follow-up (83%), suggesting that early debridement and washout in tandem with judicious use of intravenous antibiotics is key. We advocate aggressive initial surgical intervention to offset the effects of poor treatment compliance including failure to complete antibiotic regimens, self-discharge and non-attendance, often encountered in this group of patients.

In summary, hand injuries from human bites are complicated by very serious hand infections and must be treated adequately. Optimal treatment and follow-up is often difficult to achieve due to high rates of non-compliance.

### Acknowledgments

The authors would wish to thank Kim McCallister in the clinical audit department for her help in data collection.

### References

- Zubowicz VN, Gravier M. Management of early human bites of the hand: a prospective randomized study. *Plast Reconstr Surg* 1991;8:111-4.
- Szeter SRS. The Genesis of the Registrar General's social classification of occupations. *Br J Sociol* 1984;35:523-46.
- Callaham M. Controversies in antibiotic choices for bite wounds. *Ann Emerg Med* 1988;17:1321-30.
- Marr JS, Beck AM, Lugo JA. An epidemiological study of the human bite. *Public Health Rep* 1979;94:514-21.
- Dreyfuss UY, Singer M. Human bites of the hand: A study of 106 patients. *J Hand Surg (Am)* 1985;10:884-9.
- Tonta K, Kimble FW. Human bites of the hand: the Tasmanian experience. *ANZ J Surg* 2001;71:467-71.
- Maier RL. Human bite infections of the hand. *Ann Surg* 1937;106:423-7.
- Galloway RE. Mammalian bites. *J Emerg Med* 1988;6:325-31.
- Goldstein EJ. Bite wounds and infection. *Clin Infect Dis* 1992;14:633-38.
- Griego RD, Rosen T, Orengo IF, Wolf JE. Dog, cat and human bites: a review. *J Am Acad Dermatol* 1995;33:1019-29.
- Eilbert WP. Dog, Cat and Human Bites. [EmedHome Web site] 2003 Available at: [http://www.emedhome.com/features\\_archive-detail.cfm?FID=1425](http://www.emedhome.com/features_archive-detail.cfm?FID=1425).
- McGrath MH. Infections of the hand. In: McCarthy MC, ed. *Plastic Surgery*, vol 8: The hand. PA: WB Saunders Company; 1990:5534-5.
- Godoy D, Bonadeo G, Peralta H. Fight bite injuries [The Internet Journal of Emergency Medicine Web site] 2003, vol 1 Number 2. Available at: <http://www.ispub.com/ostia/index.php?xmlFile-Path=journals/ijem/vol1n2/bite.xml>.
- Revis Jr. DR. Human bite infections [eMedicine Web site] 2004. Available at: <http://www.emedicine.com/med/topic1033.htm>.
- Broder J, Jerrard D, Olshaker J, Witting M. Low risk of infection in selected human bites treated without antibiotics. *Am J Emerg Med* 2004;22:10-3.
- Smith P. Acute inflammatory conditions. In: Lister's the hand: diagnosis, indications, 4th edn. PA: Churchill Livingstone; 2002: 319-21.
- Phair IC, Quinton DN. Clenched fist human bite injuries. *J Hand Surg (Br)* 1989;14:86-7.
- Patzakis MJ, Wilkins J, Bassett RL. Surgical findings in clenched-fist injuries. *Clin Orthop* 1987;220:237-40.
- Schmidt DR, Heckmen JD. *Eikenella corrodens* in human bite infections of the hand. *J Trauma* 1983;23:478-82.
- Mason ML, Koch SL. Human bite infections of the hand. *Surg Gynecol Obstet* 1930;51:591-625.
- Mennen U, Howells CJ. Human bite infections of the hand. *J Hand Surg* 1991;16:431-5.
- Goldstein EJC, Citron DM, Wield B, et al. Bacteriology of human and animal bite wounds. *J Clin Microbiol* 1978;8:667-72.
- Talan DA, Abrahamian FM, Moran GJ, et al. Clinical presentation and bacteriologic analysis of infected human bites in patients presenting to emergency departments. *Clin Infect Dis* 2003; 37:1481-9.
- Goldstein EJ, Barones MF, Miller TA. *Eikenella corrodens* in hand infections. *J Hand Surg* 1983;8:563-7.
- Kelly IP, Cunney RJ, Smyth EG, Colville J. The management of human bite injuries of the hand. *Injury* 1996;27:481-4.
- Gonzalez MH, Papeirski P, Hall RF. Osteomyelitis of the hand after a human bite. *J Hand Surg Am* 1982;7:388-94.
- Chen E, Hornig S, Shepherd SM, Hollander JE. Primary closure of mammalian bites. *Acad Emerg Med* 2000;7:157-61.
- Perron AD, Miller MD, Brady WJ. Orthopedic pitfalls in the ED: fight bite. *Am J Emerg Med* 2002;20:114-7.

### Address for Correspondence

Patrick KY Goon, MRCS(Ed)  
Department of Plastic Surgery  
Selly Oak University Hospital Birmingham  
Birmingham B296JD  
United Kingdom  
e-mail: pat28g@yahoo.co.uk