Commentary

Remembering the Musi – SilkAir Flight MI 185 Crash Victim Identification

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Abstract

On 19 December 1997, SilkAir Flight MI 185, a Boeing B737-300 airliner crashed into the Musi River near Palembang, Southern Sumatra, enroute from Jakarta, Indonesia to Singapore. All 104 passengers and crew onboard were killed. Of the human remains recovered, 6 positive identifications were made, including that of one Singaporean. Two of the identifications were by dental records, 2 by fingerprints, 1 by age estimation and 1 by personal effects. This paper describes the crash victim identification of Flight MI 185. The authors were part of an Indonesia-Singapore forensic team deployed for 3 weeks in Palembang to assist the Indonesian authorities in human remains identification.

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Introduction

Our first impression of the Musi River was its huge size. From the air, the river looked as wide as the Straits of Johor (Fig. 1). The rotor blades of the Republic of Singapore Air Force Super Puma helicopter sliced through the air as we flew over the coffee-brown Musi. The river revealed no sign of a crash site, not even an oil spill. However, somewhere beneath the calm waters lay the wreckage of SilkAir Flight MI 185, a Boeing B737-300 jet, which had been carrying 104 passengers and crew (Fig. 2).

Fig. 1. The Musi. The wide muddy waterway near Palembang, Southern Sumatra.

Fig. 2. SilkAir Boeing B737-300 jet, a similar aircraft type to the ill-fated Flight MI 185, landed in Palembang airport carrying family members and airline officials.

MI 185 Missing

On 19 December 1997, SilkAir Flight MI 185 disappeared from cruising flight near Palembang, Southern Sumatra, on a scheduled flight from Jakarta, Indonesia to Singapore. The aircraft was believed to have nosedived into the Musi River near the village of Muara Baru about 55 km northeast of Palembang.

The high-speed impact completely destroyed the aircraft. The destruction was so extensive that most of the recovered plane wreckage comprised small mangled parts. The aircraft appeared to have come down vertically as most of the wreckage was found in a small area in the riverbed. The crash occurred in daylight and in good weather conditions.

The Hangar

The day after the crash of Flight MI 185, an 11-man forensic team from Singapore arrived in Palembang.

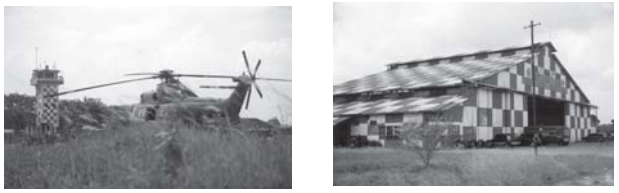

Fig. 3. Palembang airport (left). Wreckage and human remains from the Flight MI 185 crash were taken to a hangar in the Palembang airport for examination (right).

Comprising Police Criminal Investigation Department (CID) officers, a forensic pathologist and a forensic odontologist, the team was tasked to assist the Indonesian authorities in crash victim identification. In the wake of the crash, the Indonesian authorities had converted a hangar in the Palembang Sultan Mahmud Badaruddin airport into a wreckage processing point and a temporary mortuary (Fig.

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Fig. 4. The plane wreckage was washed before being moved into the hangar (background) for sorting and inspection.

Fig. 5. Ground wreckage. Except for parts of the aircraft tail section that were found on the ground (above), most of the Flight MI 185 wreckage was recovered from the bottom of the Musi River.

Fig. 6. The experts. Dr Wee Keng Poh (left), principal forensic pathologist, led Singapore's forensic assistance to the Indonesian authority. Looking on is Indonesian lead odontologist, Police Colonel Dr Peter Sahelangi (centre).

Fig. 7. Body examination. Human remains recovered from the crash were examined in a tent outside the hangar in Palembang airport.

3). Wreckage and human remains recovered from the crash site were airlifted by helicopters to a landing site near the hangar.

On arrival, the wreckage was washed before being moved to the hangar for sorting and inspection (Fig. 4). The parts were marked with the date and method of recovery (by diver or found on the ground). Where possible, wreckage parts were identified and laid out in groups such as wings, landing gears, etc. Some of the recovered aircraft parts were laid out on the hangar floor in their respective positions.

Since the crash occurred in Indonesia, the Indonesian National Transportation Safety Committee, led by Professor Oetarjo Diran**,** instituted an investigation into the circumstances of the crash. Professor Diran is a well-known pioneer of aviation engineering in Indonesia. The United States, being the country of design and manufacture of the Boeing B737 passenger plane, provided accredited representative and technical advisers for the investigation. Singapore and Australia also sent aviation experts.

In the early days following the crash, reports emerged that the main aircraft fuselage had been found in the bottom of the river. The wreckage was said to be lodged in the riverbed, with bodies of the victims trapped inside.[1] Rescuers spent futile hours trying to pry open the plane doors before poor visibility forced them to stop at nightfall.[2]

These reports turned out to be untrue. As recovery operations continued to find only small pieces of wreckage, it became evident that Flight MI 185 had completely disintegrated on impact. The largest piece of plane wreckage ever recovered was part of the empennage (aircraft tail section). It was found on land several kilometres away from the river, suggesting that the tail section had separated from the plane before the crash (Fig. 5).

American crash investigators noted the similarity of Flight MI 185 crash to the ValuJet Airlines Flight 592 accident in Miami, Florida the previous year.[3] On 11 May 1996, the ValuJet Douglas DC-9 airliner crashed into the Everglades, a swamp located in southwestern Florida, killing 110 passengers and crew. The plane was destroyed on impact, with only fragmented wreckage recovered.

Examining the Victims

Occupying one side of the hangar at the Palembang airport was the temporary mortuary, where recovered human remains were examined. An Indonesian disaster victim identification (DVI) team, led by Dr Binsar Silalahi, Head, Forensic Medicine of the Palembang General Hospital, carried out the examination. In addition to police forensic officers and pathologists, the team also comprised odontologists led by Dr Peter Sahelangi, Director of the Bhayangkara Police Hospital in Ujungpandang (Fig. 6).

Fig. 8. Mobile X-ray. A bus-mounted radiology unit, seen here outside the hangar in Palembang airport, provided imaging support to the DVI operations

Fig. 9. Body storage were in refrigerated containers located outside the hangar. Two such containers were airlifted from Singapore to Palembang by a Republic of Singapore Air Force C-130 transport plane.

The Singapore forensic team, which included Dr Wee Keng Poh, then Director, Department of Forensic Medicine, of the former Singapore Institute of Science and Forensic Medicine (now Health Sciences Authority), was assigned to the temporary mortuary to assist his Indonesian colleagues in crash victim identification. An international undertaker company contracted by Singapore Airlines also sent embalmers and forensic dentists (Associate Professor Christopher Griffith and Associate Professor John Clement of Australia and Dr Derek Clark of the UK). They brought critical equipment such as a portable dental X-ray unit, Polaroid cameras and supplies essential to DVI operations.

The hangar afforded a minimum of facilities. There was shelter and ventilation but lighting and running water were limited. One examination point was set up, where photography, property collection, fingerprinting, and medical and dental examinations were carried out. Various specialist groups took turns examining the remains on a wooden table. This body examination area was later relocated to a makeshift tent outside the hangar (Fig. 7).

A bus-mounted mobile x-ray unit from a local hospital arrived to provide radiology support (Fig. 8). It was parked outside the hangar throughout the DVI operation. For storage of body parts, a Republic of Singapore Air Force C-130 transport plane airlifted 2 refrigerated containers from Singapore to the Palembang airport (Fig. 9). They were trucked to the hangar for immediate use. Although basic, the facilities were sufficient under the circumstances.

Initially, the DVI team had braced itself to receive a large number of bodies. There were early media reports of divers finding victims' bodies trapped inside the submerged plane wreckage. However, for several days following the crash, the hangar mortuary received no human remains. In spite of continuous diving operations, only small pieces of aircraft wreckage were found. From the mangled wreckage, initial disbelief gave way to the realisation that the aircraft had been destroyed in a high-speed impact. The hope of finding significant human remains faded.

Table 1. Passengers and Crew of SilkAir Flight MI 185 Comprised 14 Nationalities

American	5	Indonesian	23
Australian	1	Japanese	2
Austrian	1	Malaysian	10
Bosnian	1	Taiwanese	1
British	3	New Zealander	1 (First Officer)
French	5	Singaporean*	46
German	4	**Total**	**104**
Indian	1		

* Including pilot and 5 cabin crew

Identifying the Victims

The SilkAir crash claimed 104 lives (Table 1). Four days after the crash, the first batch of human remains arrived at the hangar mortuary. A total of 37 body parts were received. Most of these remains were small fragmented body parts, including several human hands severed at the wrists. Using thumbprints, Singapore Police CID officers later identified one of the right hands as that of a Singaporean passenger.

Most of the severed hands were left hands. Malaysian citizens carry identity cards that contain both their right and left thumbprints. This contributed to the identification of a Malaysian national whose identity card was recovered from the wreckage. The thumbprints on the identity card matched one of the recovered hands. The fingerprints records of Singaporean were only of the right thumbs, so they could not be matched with the left hands that were found.

The largest body part in that batch of remains belonged to a child, likely Caucasian because of the golden hair. There had been 2 blond children onboard Flight MI 185 – a 5-year-old girl and a 3-year-old boy, a pair of German siblings. Too small to belong to the older child, the remains were later identified to be that of the younger boy, who was the youngest passenger onboard the plane.

Christmas Day saw another positive identification. A severed finger with a 3-piece ring was found. The ring was

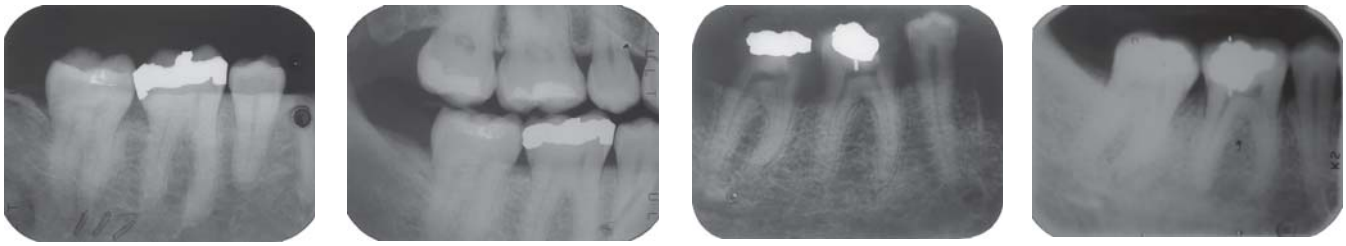

Fig. 10. Positive match. Dental radiographs identified the jaws remains of 2 female American passengers. A comparison of their postmortem (left) and antemortem intra-oral radiographs revealed morphologic concordance of teeth and restorations.

Fig. 11. Dredging of the Musi riverbed produced more wreckage and human remains.

Table 2. Dental Records of Flight MI 185 Passengers Received

American	3
Australian	1
Austrian	1
British	2
German	1
Indonesian	2
Japanese	1
Malaysian	2
New Zealander	1
Singaporean*	35
Total	**49**

inscribed with the date 16 December 1989 and the initials M & M. The ring pointed to a French couple onboard the plane, which was later determined to be the husband's. The French embassy in Jakarta confirmed the couple's wedding date, as inscribed on the ring.

Apart from these identifications, the rest of the body parts received were small and unidentifiable. By year-end, a total of 134 pieces of body parts had been recovered. They were embalmed and stored in the refrigerated containers. No further identification was made until the end stage of DVI operations.

Dental Identification

There were 2 positive dental identifications. Two jawbones were the last human remains to be positively identified from Flight MI 185. Dental records showed that they belonged to 2 female American passengers. The first jawbone, the right half of a mandible, was recovered 9 days after the crash. It contained the root remnant of a fractured lower premolar (Tooth 44) and 3 intact posterior teeth (Teeth 45, 46 and 47). The dental remains were examined and periapical radiographs of them taken.

Dental identification is based on a systematic comparison of antemortem and postmortem dental records. The more accurate and complete the antemortem dental records, the greater the possibility of a positive identification. The first recovered jawbone was the first to be identified by its teeth. A comparison of the jawbone and the dental records of an American passenger provided by the US authority revealed numerous points of concordance. The records, supplied by a private dental practitioner in the United States, consisted of a dental chart, treatment notes and dental radiographs. The postmortem dental radiograph of the jawbone matched the missing passenger's dental radiographic records (Fig. 10).

More human remains were found when dredging of the Musi River began on New Year's Eve. Two dredger vessels, the *Oceana* and *Musahi* took turns dredging the riverbed, using a crane with a clamshell scoop. The excavated materials were transferred to a barge and deposited on a giant sieve. There, the water was drained, leaving the debris for workmen to sift through (Fig. 11). After 2 weeks of slow wreckage recovery using sonar equipment and navy divers, the dredging began to produce truckloads of wreckage, personal belongings and body parts, including 22 pieces of skeletonised jawbones.

The teeth of the jawbones were brushed clean for photographic documentation. None of the jaws were intact, the largest of which was the body of a mandible missing both its rami. Only partial postmortem dental records could be made but all the teeth of the jawbones were radiographed.

From these jawbones, a second positive identification was made. The right half of a mandible consisting of 3 intact posterior teeth (Teeth 45, 46 and 47), was identified by dental radiographs to be that of another American passenger. This second dental identification was made after the Singapore forensic team had returned home. On 15 January 1998 back in Singapore, Dr Tan Peng Hui received a set of dental radiographs of a missing female American passenger from the Singapore Police CID. Earlier that day, CID officers had picked up the radiographs from the United States Embassy in Singapore. The radiographs consisted of 2 bitewings and 14 periapical films. Several of

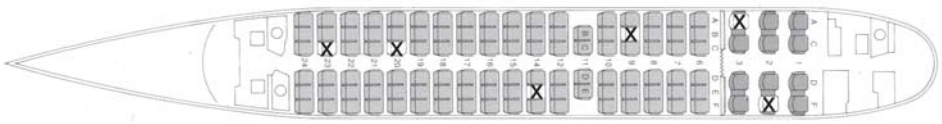

Fig. 12. Cabin seats of the six Flight MI 185 passengers whose remains were found and identified.

the radiographs matched the postmortem dental radiographs of the jawbone found by dredging.

Of the 104 passengers and crew onboard Flight MI 185, the dental records of 49 passengers were obtained, including those of 35 Singaporeans (Table 2). At some time, most of the Singaporean passengers had been to a dentist. The police spared no effort in securing their dental records. Before long, a nation-wide search for the dental records of Singaporeans passengers was underway. Through circulars and newsletters, the Singapore Dental Association circulated the name list of missing Singaporeans to all its members. This effort helped the police quickly gather their dental records.

The Singaporeans' dental records, which comprised written notes and radiographs, were mostly provided by private dental practitioners. The Singapore Armed Forces provided detailed military dental records of the aircraft pilot, Captain Tsu Way Ming, including his orthopantomogram and dental models. Prior to joining SilkAir, Captain Tsu had been a fighter pilot in the Republic of Singapore Air Force. Although his airline security pass was found, no identifiable remains of Captain Tsu were recovered.

Discussion

Recent disasters have occurred after work hours, on weekends or during holiday seasons. The parallels are uncanny. The Indonesian Yogyakarta Bantul earthquake in May 2006 occurred on Saturday and the Nias earthquake in March 2005 on Sunday. Both killer earthquakes struck during hours of darkness. Besides the SilkAir Flight MI 185 crash, which happened in December 1997, both the Iranian Bam earthquake in 2003, the Asian Tsunami in 2004 and the Taiwan earthquake in 2006 had occurred on Boxing Day.

Disasters, when they occur during the holidays, can complicate disaster victim identification, e.g. in the gathering of antemortem dental records. Often, dental clinics are closed and their dentists away on vacation. The Christmas and New Year holidays may have slowed the collection of Flight MI 185 overseas passengers' dental records. Apart from Singaporeans and Indonesians, only the dental records of 12 foreign nationals were obtained when DVI operations were wrapped up on 8 January 1998.

In the SilkAir crash, the body parts of 6 passengers were identified. Of the 104 caskets later buried in a mass grave in Palembang, 6 bore the names of the identified. Dental records accounted for 2 of these identifications. Fingerprints, personal effects and age estimation contributed the rest. Of the 6 passengers identified, 4 had been sitting on the left side of the plane while 2 others had been sitting on the opposite side (Fig. 12).

The fragmented remains recovered from Flight MI 185 were reminiscent of the 1996 ValuJet Flight 592 crash in Florida. In that crash, only mangled body parts were found including 11 dental fragments.[3] Three were mandibular ramus fragments, which were unidentifiable. Of the remaining 8 fragments, 3 positive identifications were made.

Dental radiology is invaluable in the identification of fragmented dental remains. Dental radiographs are preferred to written records for the identification of jaw fragments because they contain a myriad of details and because of their objectivity for visual verification. When examining incomplete dental remains, all the teeth present have to be radiographed.

Major disasters involving a large number of fatalities raise questions about the certification and disposal of human remains. For example, does a complete body need to be found before a death certificate can be issued. Or can an identifiable body part whose loss is incompatible with life confirm the death of an individual? Conversely, can a person be declared dead when body parts, identifiable by fingerprints or odontology, have been found but whose loss is not incompatible with life? The management of additional body parts found after the identified body has been returned to the family also requires careful consideration. These policy decisions are best deliberated between disasters, with leisure of time and without pressure.

Cause of the Crash

It was a new aircraft. The Boeing B737-300 of SilkAir Flight MI 185 was just 10 months old at the time of the crash. It was the newest plane in the SilkAir fleet and was a favourite of the pilots because of its trouble-free record.[4] The jet had passed a maintenance check 10 days before. For a long while, the cause of the accident was a mystery.

In a final aircraft accident report dated 14 December

2000, Indonesia's National Transportation Safety Committee stated that given the limited information from the wreckage and flight recorders, it was unable to find the reasons for the aircraft's departure from cruising height and the reason for the stoppage of the flight recorders.[5]

However, the United States National Transportation Safety Board (US NTSB), which had provided accredited representative and technical advisors for the investigations, concluded that no airplane-related mechanical malfunctions had contributed to the accident.[6] Instead, the airplane's flight profile could be explained by intentional pilot action. According to the NTSB, there was evidence to suggest that someone had manually pulled the circuit breaker in the cockpit to intentionally disconnect the cockpit voice recorder.

In a separate investigation into whether a criminal offence might have caused the crash, the Singapore Police CID found no evidence that the pilot or anyone else on board may have had suicidal tendencies or a motive to cause the crash.[7] The Singapore accredited representative to the investigation stated expressly that the wreckage of the cockpit and circuit breaker panel had not been recovered.[8]

By May 2003, an emerging body of new evidence suggested that Flight MI 185's flight data recorder had not stopped recording until shortly before the crash.[9] The recorder also showed an unusual full rudder deflection. Such a rudder position would have caused the jet to swerve sharply and snap into a roll (Fig. 13). In July 2004, a Los Angeles court in the United States ruled that the Flight MI 185 crash had been caused by a defective servo valve in the plane's rudder.[10] The rudder manufacturer was ordered to pay the families of victims.[11]

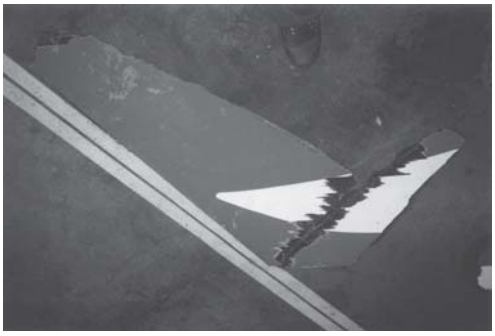

Fig. 13. The rudder. Wreckage from the aircraft's tail fin.

The Boeing 737 rudder trouble was not new. In March 1999, the US NTSB identified a jammed valve in the rudder control system to be the probable cause of the crash of USAir Flight 427, a Boeing 737 in September 1994. The investigation examined 2 other mishaps involving Boeing 737s, the 1991 crash of United Airlines Flight 585 in Colorado Springs and the 1996 near-disaster incident involving Eastwind Airlines Flight 517 in Virginia. The Board had concluded that the same type of rudder failure had most likely occurred in both cases.[12]

The SilkAir Flight MI 185 crash was Singapore's first major air disaster. Few who responded to the disaster were untouched by it. This article is dedicated to the memory of the passengers of Flight MI 185 and their families, who faced hardship and heartbreak with grit and courage (Fig. 14).

Fig. 14. In Memory. Three female Singaporean teachers from the Fairfield Methodist Secondary School were onboard Flight MI 185.

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