Technical Report: on the Effective Use of Footprints

By Akira MITSUZANE
Former chief of the Identification Division, TMPD
(63rd chief of the First Criminal Investigation Division, TMPD)

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I. Why I was motivated to promote the use of "footprints"

In 2013, two years after the Great East Japan Earthquake, there was a newspaper article about more than 100 casualties whose names had not been identified and that some corpses had been mix up. As the chief of the Identification Division of the Tokyo Metropolitan Police Department (TMPD), I myself had difficulties in the identification of corpses in times of incidents and accidents. Therefore, I contributed an article to the monthly magazine, "Bungei Shunju" on the effectiveness of using "footprints" in times of disasters and there was another article which appeared in the police magazine, "BAN", in which two former members of the TMPD's Identification Division and I suggested the use of footprints for identifying corpses in times of disaster. These two articles received reaction from Professor Emeritus Shoichi WATANABE of Sophia University, who advocated the use of "fingerprints."

In 2015, NEC (Nippon Electric Company, Limited) made a test production of live scanners to capture footprints. The emergence of this product prompted us to engage in the enlightenment and promotion activities on the use of footprints as a way of scientifically checking the identity of persons.

II. What is a footprint?

A footprint refers to a dermatoglyph, which is made up of dermal ridges and skin grooves seen on the sole of a foot. It is also called a pelmatogram and could be widely defined as the mark of a naked foot (foot mark) and even a footwear impression. Compared with fingerprints and handprints, footprints tend to become undifferentiated, and lifting footprints is often difficult. For those reasons, footprints, in practice, have a limited range of applications. However, as is the case of fingerprints, footprints differ from person to person and never change throughout our lifetime. Therefore, they can be used for personal identification with absolute accuracy.
(Taken from Nipponica Encyclopedia)

III. Scientific method for personal identification

The standard procedure observed by the police when the identification of corpses is

made is as follows: Members of the deceased person's bereaved family are first interviewed about the person's bodily characteristics to find any match with the corpse. Bodily characteristics include the person's height/weight, hairstyle, facial characteristics, operative scars, moles, bruise, and tattoos. We also take other things into consideration, such as the person's clothes and accessories, including rings and pierces, before we come to the conclusion. When turning the corpse over to the bereaved family, we ask the family to check the corpse in person.

In case the corpse is badly decomposed or in the process of decay, we cannot accurately examine bodily characteristics. In addition, mental burden placed on the members of the bereaved family can be overwhelming. In that case, we make identification of the corpse using scientific methods, such as fingerprints, dental findings, and DNA. However, using scientific methods can cause obstacles as well. The cross-checking of fingerprints is limited to those with criminal records in the police database. In examining the deceased person's teeth, we need to obtain dental records from the dentist where the person attended. In the case of DNA, we need to find a member of the person's next of kin, whose DNA can be compared.

In normal circumstances, the deceased person's fingerprints and DNA can be compared with fingerprints lifted from things used by him/herself, such as his/her diary and notebooks, and the type of DNA taken from his/her comb, and toothbrush. However, in cases of major natural disasters, such as earthquakes, tsunamis, and floods, many of dental records and "things used by the deceased persons" are already lost. Due to a decrease in the number of children and an increase in the number of single households, there are even times when we cannot easily find the deceased person's next of kin. In that case, there is no way of perfectly identifying the corpse.

IV. Effectiveness of footprints

Experts predict that strong earthquakes will directly hit Tokyo and the region along the Nankai Trough (coastal regions on the Pacific Ocean side in western Japan) and cause heavy casualties in the not-too-distant future. If such earthquakes are to occur in the broad daylight, it is beyond imagination to identify all the victims. It will be especially difficult to identify corpses of a number of tourists who are unrelated to the area where the earthquakes occurred.

Undoubtedly, what is important in the measures against disaster prevention is how we can prevent and reduce the casualties when confronted with forces of nature. The reality is, however, we cannot identify all the victims in times of disaster. One of the challenges we face today is how we can apply a lesson we learned from such a historic catastrophe as the

Great East Japan Earthquake. However, it seems that we have not engaged in any serious discussion on that.

As in Thailand and South Korea, we could require all of our citizens to register their fingerprints. However, we are also highly conscious of privacy. If we implement such a mandate, there will probably be a lot of backlash from the public. It is for that reason that I would like to suggest the use of footprints, as they also differ from person to person and never change throughout our lifetime.

Other than disasters, footprints may be utilized for people with dementia who have the habit of wandering around. In the event of unexpected contingency abroad, be it incidents or accidents, checking one's footprints is considered a scientific method for identification, which is applicable in the coronial system[1] widely accepted in many countries.

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[1] The coronial system

It is the system in which coroners conduct autopsy and make clear the circumstances that lead to one's death, which is adopted in such countries as the United Kingdom and Austria. (The main purpose of the coronial system is not to conduct criminal investigation or maintain public health.)

The death is reported to a coroner in the following circumstances: unnatural death, death due to accidents and external injury, and death while in custody. In addition to those circumstances, "death whose identity has not been confirmed" should be reported to a coroner as well.

V. Competitive advantage of footprints over fingerprints

Together with fingerprints, biometrics, such as vein or iris recognition, are now deployed for immigration control and as countermeasures against international terrorism. We also see biometrics at an increasing number of facilities, and many digital devices are now compatible with iris. They have become so entrenched in our society that the public feels more at ease with the use of biometric authentication. However, realistically speaking, the public still has vague anxiety and wariness over the use of fingerprints in the police investigation.

Footprints may be used as a tool for criminal investigation, but cases of robbery, theft, or sexual assault, in which perpetrators break into a residence on barefoot, are extremely rare. The National Police Agency does not have the database of footprints unlike that of fingerprints.

Compared with the fingerprints, footprints have the following unique characteristics:

- With a large area on the sole of the foot, they have more than 1,000 minutiae points.
- Faking or surgically altering footprints are difficult.
- They are not used for security.
- As the sole of the foot has thick skin, they are less likely to go damaged or decayed.
- Protected with shoes or socks, they tend to stay intact.

There is another advantage of footprints over fingerprints. As we do not have to widen the palm of the stiffened corpse and lift fingerprints by rolling the palm around, it is relatively easier to lift footprints.

On the other hand, there are some difficulties involved in lifting footprints. First, we have to take off shoes and socks and go on barefoot. Lifting footprints also brings a sense of shame to those who have foot skin diseases, such as big toe bunions.

VI. Lifting of footprints and method for examination

In order to lift footprints, a foot must be first placed on the stand. We then dab the sole on an ink pad and obtain an impression on a sheet. Examiners take a close look at the impression and extract minutiae points. As is the case of fingerprints, if twelve minutiae[2] are present, two sets of footprints are of the same person.

Live scanners developed by NEC for lifting of footprints were originally manufactured for lifting of fingerprints. They are therefore the remodeled version made exclusively for lifting of "footprints." Once the sole of the foot is set on the glass surface, the footprint gets scanned automatically. One can print out the impression and easily find minutiae points. Furthermore, the scanner has the function of cross-checking the impressions with other footprints and by giving the number of matching minutiae, can actually decide whether or not the two footprint sets are of the same person.

The police have hailed the scanner as being "superb", but they hardly ever use footprints in the criminal investigation. Given the relatively high price of the product, they did not find "cost-effectiveness" in the product. They were therefore not motivated to introduce it in their daily routine.

We then sought possibility of putting the product to practical use in other countries, where finding barefoot prints is more common on the crime scene. In 2015, the NEC's scanner was displayed during the footprint seminar held at the Royal Thai Police. Senior members in charge of identification at the Thai National Police showed strong interest in the product, but once again due to the high cost, they showed hesitation about introducing it in their routine work.

[2] Minutiae to be cross-checked

In addition to shapes of ridge lines, ridge endings, ridge bifurcations, and island-shaped lines, which make each fingerprint unique, must be extracted.

- Examination Standard for Dermatoglyphic Pattern -

Considering the fact that there is only one in a 100 billion chance of finding 12 matching minutiae, we judge if the two prints are of the same person.

VII. Commencement of promoting activity and its repercussion

Enlightening activities of footprints began in 2016 in my birthplace of Suzu, Ishikawa prefecture. I gave a speech there one day, but the event was also used as an opportunity to lift footprints from local residents who came to listen to my speech. By holding this event, I was also hoping that the city would be recognized as the birth place where footprints were first put to practice use.

Initially, we used the NEC's scanner to lift their footprints and gave each one who provided his/her footprint a sheet with impressions of their footprint. Probably due to its novelty, there was a lot of interest from the public. At one point in time, there were a number of people waiting in line. A reporter from NHK (Japan's public broadcaster) praised the event, saying, "This must be a big discovery. It's like the egg of Columbus." His report about the event was televised nationwide on NHK's morning news program on July 8, 2016. However, the truth is that there was only a fraction of people even within the police force who knew there was such a thing as a footprint. It seemed that very few people even dared to think about utilizing it.

As people provided their footprints on other occasions, such as at sporting events, I began to think that one of the challenges facing the use of footprints is "how we store and maintain them." Out of a playful spirit, I thought about an idea of creating the "Certificate of Footprints" and delivered to those who provided their footprints. They were all pleased to have received such a certificate from us.

VIII. Maintaining of footprint database

I made a request to the City of Suzu to consider if the footprint data provided by local residents could be kept by the city. However, partly because of the issues surrounding personal information, the city showed reluctance to the idea.

In promoting the use of footprints, there were a lot of obstacles even from the initial stage, such as introducing lifting devices and deciding which authorities should be empowered to lift footprints, as well as maintaining personal information. It was expected

that promoting the use of footprints would go a long way.

In order to put the use of footprints into the system, I believe we have to go through three stages: first of all, we need to promote the existence and usefulness of footprints. Secondly, we take procedures in lifting footprints from the public. Lastly, we decide on the managing authorities that should handle the database. Maintaining and handling the database is the most difficult hurdle to overcome.

For the time being, enlightening activities and advancing the lifting of footprints would be a realistic way of "promoting the use of footprints." As long as the data is kept personally or within the family, it can be useful immediately in times of disaster or accident, and even when people with dementia wander around at night.

IX. Current state of identifying corpses

Here is a run-down on the current state of identifying corpses

- There are still 69 corpses from the Great East Japan Earthquake whose identity has not been confirmed.
- In Tokyo alone, there are more than 3,000 corpses in the last 20 years, whose identity was not confirmed.
- There are around 100 unidentified persons nationwide whose lives should be protected.
- In the aftermath of the sinking of MV Sewol in South Korea, three corpses were mixed up.
- Due to the differences in the coronial system between Japan and New Zealand, it took more time to identify Japanese victims of the earthquake which struck New Zealand in 2011.

What is worse, if major earthquakes are to directly hit Tokyo area and the region along the Nankai Trough, it is expected that there will be roughly 23,000 and 323,000 deaths respectively. One can easily imagine there will be tremendous work ahead to identify each corpse. In addition, in 2016 alone, the number of dementia patients who went missing surpassed 15,000. In the aging society, the number is expected to rise. In other words, there has been more work associated with the identification of corpses recently.

Again, in order to securely conduct the identification of corpses, we need to rely on one of these forensic examinations: fingerprints/footprints, teeth, or DNA.

Then, does the responsibility lie only on the police for the identification of corpses? Under the Identity (corpse) Inquiry Act, which went into effect in 2013, "the police can seek cooperation from doctors and dentists to establish the cause of death or verify the identity of corpses." In the aftermath of the 1985 Japan Airlines jumbo jet crash in Gunma prefecture in

August 1985, which is the deadliest single aircraft accident in aviation history, thanks to all-out efforts by members of Gunma Dental Association, 233 corpses out of the 518 deaths were positively identified by dental examination.

In order to take precautions against major earthquakes, there have been efforts by members of dental associations nationwide to compile the data on dental records. I would like to pay due respect for their hard work. However, dental records should be characterized as personal information as in the case of fingerprints or footprints. If more data on fingerprints or footprints are compiled, we will not have to rely excessively on dental records, and the burden shouldered by dentists will be reduced.

Advances in science and technology are remarkable. At the crime scene investigation, DNA tests have taken the place of fingerprints and have emerged as the key player in the forensic investigation.

However, the disparity in the cost between DNA tests and fingerprints examination is enormous. Colonel Kunio TOSHIMA of the Royal Thai Police, who played a key role in the identification of tsunami victims of the 2004 Indian Ocean earthquake and tsunami, suggested the lifting of fingerprints by cutting off the victims' fingers. He did not even worry about receiving punishment for doing that. As a result, he made outstanding achievements by successfully identifying more than 40 million bodies in the early stage.

Last year, while engaging in talks with members of the Office of Police Forensic Science at the Thai Royal Police, Police Major General Tawatchai turned our attention to DNA tests, saying, "if Japanese people had reservations about providing their fingerprints, why not try DNA tests instead?" When I told him it would cost us around 100,000 yen to conduct one DNA examination in Japan, he nodded with laughter and said, "It would cost 3,000 baht (around 10,000 yen) in Thailand. For fingerprints and footprints, you would get impressions on papers, so it would cost only 1 baht (about 3 yen)."

In addition to the high cost involved, DNA tests take at least a few days to complete. On the other hand, examining fingerprints or footprints is simple and quick. Instead of keeping the corpse, we can quickly hand it over to the bereaved family. In that way, we can relate well to the feelings and emotions of the family, who hopes to be close to their loved one soon.

X. Lifting and maintaining of footprints (fingerprints)

I discussed the effective use of footprints in great detail. If the identification of corpses is done by using scientific means, family members of the deceased persons will not have to see the corpses in person, which I am sure will alleviate or erase the anxiety of the bereaved family.

In enlightening and promoting the use of footprints, we often question which public authority to handle the issues. Should it be handled by people in charge of anti-disasters or welfare, or by the police? As in the case of fingerprints, if the public has a sense of caution about the use of footprints, I do not think that the police should be actively involved in this issue.

Also, if the public has reservations about using footprints “systematically”, we can ask only those who are interested if they want to provide their footprints. As a way of promoting the use of footprints, we could emphasize the merits of people who offer to provide their footprints. For example, if corpses are successfully identified by footprints, we could pay some money as a token of condolence to the bereaved family or add extra value to their life insurance premium. However, lifting of footprints should be done by public authorities and any labor costs and other expenses that may be incurred should be borne by public funds.

In any case, I truly hope that the issue of footprints will be wildly discussed among people from all walks of life, whether they are in the public or private sector.

Turning to a different perspective, in order to promote the use of footprints, it may not be necessary to put it in systematic order. In Japan, in order to congratulate sumo wrestlers on their promotion to the top two “sekitori” divisions, or to record the healthy growth of children, handprints or footprints have traditionally been taken. To that end, I could even make the following suggestions:

a) Scanning devices may be incorporated into weight scales, and whenever medical check-ups are held, footprints can be scanned and kept by medical institutions.

b) Footprints may be fused into “handprints & footprints art.”

c) Pages of footprints may be allocated to “ending notes (which include informal living will).”

In other words, we could keep our footprints anywhere we like.

In preparation for any disaster or unexpected contingency, I believe there will be a day when we have to “prove our identity” on our own. It only takes once in a lifetime to lift our own footprints. When it comes to the crunch, you will feel better safe than sorry.

(This is an appended text based on the summary of the speech made by Mr. Mitsuzane at the Shiga Prefecture Forensic Association on August 31, 2017.)

Association for Promoting the Use of Footprints (Director: Akira Mitsuzane)
Established in January 2016
Re-named in February 2019 to the National Association for Promoting the Use of Footprints
Address: 7-10, Minami-oi 6-chome, Shinagawa-ku, Tokyo, Japan 140-0013
Telephone & Fax: +81-3298-2300