Prostheses for amputees in the Meiji Era: Three case studies

Yoshiko TSUBOI (Member)

Abstract

The purpose of this study is to elucidate the process of development of extremity prostheses by looking at 3 cases from the Meiji Era. The Meiji Era was a period when Japan acquired new ideas and great efforts were made to catch up with modern Western countries. The investigation was conducted through interviews with several persons concerned and by examination of recently discovered records.

The cases are summarized as follows:
1. Tanosuke Sawamura III (1845-1878), a Kabuki actor, whose right leg was amputated due to gangrene, ordered an artificial leg from Kisaburo Matsumoto, a ningyoushi (a maker of dolls). This prosthesis had a beautiful appearance, but was not practical.
2. Shigenobu Okuma (1838-1922), an elite politician who lost his right leg in a terrorist incident, was presented a prosthesis by A.A. Marks Co. in the U.S.A. Okuma was greatly satisfied and wrote a letter of thanks. At that time, however, imported prostheses were not only expensive to obtain but also not well adapted to the Japanese life style.
3. Yuichi Suzuki (1872-1921), who lost his right leg in an accident at the age of 16, made great efforts to develop an artificial leg to fit himself. He later established a prosthetics production company.

Key Words

extremity prosthesis, amputee, figure maker

I Introduction

It was extremely difficult for limb amputees to obtain prostheses in the Meiji Era (1867-1912). Prostheses are the artificial arms and legs of people who have lost some or one of their limbs and are used to replace the form and function of the lost limbs. Prostheses for the upper extremities are called artificial arms and those for the lower extremities are called artificial legs. Artificial legs, in particular, allow for movement, enlarging one's sphere of living, making life in society possible, and are related to one's will to live.

The study of the development of artificial legs and the progress of physically disabled people in Japan is closely tied to the relation between medicine and technical progress in the production of artificial legs, and also...
means looking at how society dealt with the physically disabled. This is, in other words, the unique history of rehabilitation in Japan.

There has been very little research on prostheses in Japan, the first publication being "On Artificial Arms and Legs" by a long-suffering amputee, Yuichi Suzuki. Katayama published an article in Medical Affairs (Iji Kouron) entitled "On the history of prostheses." According to this article, the first Japanese person to use an artificial leg was Kabuki actor, Tanosuke Sawamura III. He asked Kisaburo Matsumoto, maker of lifelike dolls, to make an artificial leg for him, but it is noted that it was not practical as a leg. Iida reported that the American Company A. A. Marks presented a thigh socket to politician and amputee Shigenobu Okuma. Takechi has also touched on the subject of Tanosuke Sawamura's artificial leg, but gives no more than the information found in the articles mentioned above.

This research looked at the development of artificial limbs in the Meiji Period in Japan from a historical point of view by reviewing the literature, concentrating mainly on three case studies of Tanosuke Sawamura, Shigenobu Okuma and Yuichi Suzuki. In order to clarify certain problems and explain points that were not clear from previous studies, interviews were held with people who had been involved with the cases.

II Case Studies

1. Life with an artificial leg · Tanosuke Sawamura
   Kabuki actor Tanosuke Sawamura (1845-1878) came to need an artificial leg after the leg he had injured on stage in March, 1865 became gangrenous. His leg was amputated at the right thigh on September 15, 1867 by American James Curtis Hepburn (1815-1911). It was written in the Kabuki Chronicles that he underwent surgery without anesthetics, but chloroform had been used for Tanosuke's surgery and was one of the first experimental cases to take place before the Meiji Restoration. Sawamura asked Kisaburo Matsumoto (1825-1891), maker of lifelike dolls, to make him an artificial leg, but the balance with his good leg was not right and he couldn't use the device. This is because the leg was made to look good, but not to be functional. But the leg Kisaburo Matsumoto made for Tanosuke was to leave a big footprint on the history of prostheses in Japan.

   Lifelike dolls are lifesized dolls made to look exactly like people. They were popular with the common people at the end of the last Tokugawa Shogunate and viewing them was a favorite pastime of the masses. Kisaburo Matsumoto was the king of lifelike doll makers at the time. He had contact with the medical field in 1872 when he was asked to make a human anatomy model for the university that is the present day University of Tokyo. Professor Jun Matsumoto of the university sent words of praise to Kisaburo for the extremely excellent quality of the human model he made. He was also honored by the government in 1873 by being asked to display his work "Skeletal Connections" at the World Exhibition in Vienna. The Finance Minister at that time, Shigenobu Okuma, sent him a letter of thanks.

   The leg Kisaburo Matsumoto made for Tanosuke Sawamura was not practical, but it had good value as an ornamental leg.

   The next new innovation in artificial legs in the Meiji Period came from prostheses imported from abroad. The artificial leg Tanosuke Sawamura asked Hepburn to send him from America (made by the Selpho Company) arrived in 1868, allowing him to appear on stage. It cost him 200 ryo (a huge sum equivalent to several million US dollars today).

   Selpho made a prosthesis for a Dr. Palmer who had emigrated from England to America in 1839 and introduced the Anglesea Leg to many. This artificial leg was made on the order of Marquess Anglesea for Selpho's benefactor, James Potts, who had lost his leg in the Battle of Waterloo. This was an improved version of the wooden legs which had been used up until then and was given a patent by the British government. It was widely known as the Anglesea Leg. It was also known as the Clapper Leg because of the clattering sound the leg made. This sound was characteristic of the sound the leg made while walking. The socket attached to the amputated limb. The leg parts of this prosthesis were made of wood, with the toes able to bend backwards. There were two strings which served as tendons attaching the knee to the heel, and the lower thigh to the toes. This allowed the foot to push off from the ground while walking. The sole of the foot was covered with rubber to provide elasticity and to prevent slipping.

   Selpho made a prosthesis for a Dr. Palmer who had had a leg amputated. Benjamin F. Palmer improved this prosthesis and designed the "Palmer Prosthesis".
In 1846, he received the first patent in the United States to manufacture prostheses. He received an award for his design at the International Exposition held in London in 1851. It was known as the "American Leg" from then until the First World War. Thus the artificial leg used by Tanosuke Sawamura, manufactured by Selpho, was of the most advanced type at that time in the 19th century.

The gangrene in Tanosuke's leg spread to his left lower thigh and in 1870 his left lower thigh was amputated. The gangrene spread further to his upper limbs. His right wrist and four of the fingers on his left hand were amputated, basically spelling the end of the career of this actor. But Tanosuke still did not lose his love of Kabuki, and by one means or another, did what he could with what he had. Tanosuke appeared in the Kabuki play "Kokusenya Sugatano Utsushie" written by Kawatake Mokuami in 1872, playing the part of Kokin. Borrowing the set for another play, "Kokusenya Gassen," he acted out the three generations of Tanosukes to conclude his career. He had a special chair built for him so that he could move in all directions at will on the tall Ronon stage set. It was basically a wheelchair which could be pushed in all directions. This totally unexpected device attracted great attention from the audience. The audience was moved to tears by Tanosuke's performance.

Later in his life, his brain was affected by lead poisoning, causing frequent epileptic attacks. He died on July 7, 1878 at the age of 33 years and 6 months.

2. Shigenobu Okuma (1838-1922) lost his right leg to a bomb thrown by a terrorist who was opposed to the revision of a treaty made on October 18, 1889. He had a prosthesis made. His injuries are described in detail in his medical charts from the Waseda University archives. According to this source, his lower leg was injured by shrapnel from the bomb explosion in front of the Foreign Ministry at 4 PM. He had complex bone injuries to the lower right thigh. Fortunately for Okuma, Kanehiro Takaki, Inspector General of the Navy's Medical Division, arrived at Okuma's bedside just a few minutes after the explosion, and provided emergency treatment to minimize the bleeding. Then, Tsunatsune Hashimoto, Inspector General of the Army's Medical Division, Okuma's own physician Kensai Ikeda, Honari Ito, Susumu Sato, Doctor Bals and Tsunamoto Koukai all arrived at his bedside. Surgical treatment was carried out under chloroform anesthesia by Susumu Sato, with the help of Hashimoto and Takaki.

An artificial leg was sent from the A. A. Marks Company of the U.S. right after the surgery. Improvements to the prosthesis were added every year. The A. A. Marks Company owned 10 patents and was the most advanced manufacturer of prostheses in the U.S. at the time.

The Waseda University Archives have a letter from the A. A. Marks Company thanking Shigenobu Okuma for using their prosthesis and asking permission to use his letter of recommendation. The artificial legs of the A. A. Marks Company placed Number 1 for two years in a row at the International Exposition held in Atlanta, Georgia. It was given the highest honor of Gold Medal and it was reported that the company was the only company making prostheses to have received this award (Fig. 1). There are five artificial legs used by Shigenobu Okuma remaining in Waseda University. The author has made a detailed analysis of the 5 legs. This data is invaluable for what it shows us of the history of the
Table 1 Use of prosthetics bestowed as Imperial Gift (from a survey on prosthetic use, Feb. 7, 1921)

<table>
<thead>
<tr>
<th>Limb</th>
<th>Use</th>
<th></th>
<th>Do not use</th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Always</td>
<td></td>
<td>Sometimes</td>
<td></td>
<td>Rarely</td>
<td>Broken</td>
<td>Inconvenient</td>
</tr>
<tr>
<td>Upper arm</td>
<td>10</td>
<td>23</td>
<td>97</td>
<td>53</td>
<td>53</td>
<td>113</td>
<td>349</td>
</tr>
<tr>
<td>Lower arm</td>
<td>3</td>
<td>6</td>
<td>25</td>
<td>11</td>
<td>17</td>
<td>27</td>
<td>89</td>
</tr>
<tr>
<td>Hand</td>
<td>1</td>
<td>9</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>17</td>
<td>67</td>
</tr>
<tr>
<td>Thigh</td>
<td>44</td>
<td>13</td>
<td>66</td>
<td>101</td>
<td>142</td>
<td>160</td>
<td>526</td>
</tr>
<tr>
<td>Lower leg</td>
<td>97</td>
<td>15</td>
<td>23</td>
<td>194</td>
<td>49</td>
<td>17</td>
<td>395</td>
</tr>
<tr>
<td>Foot</td>
<td>29</td>
<td>5</td>
<td>9</td>
<td>73</td>
<td>26</td>
<td>26</td>
<td>168</td>
</tr>
<tr>
<td>Total</td>
<td>184</td>
<td>71</td>
<td>230</td>
<td>447</td>
<td>302</td>
<td>360</td>
<td>1,594</td>
</tr>
</tbody>
</table>

1688 responded out of 1700 surveyed; 77 had died; the whereabouts of 17 were unknown. From Saito Iateki.

The manufacturing of artificial legs in the U.S. and the development of prosthetics in Japan.

The first photograph shows a wooden prosthesis that could flex at the foot and had two strings going from his knee to the heel and toes. Its shape, the quality of the material and the functionality all indicate it is an American prosthesis. The prostheses in pictures 2 and 3 have many similarities. The toes are produced with great precision and the movement of the knee joint uses a spring mechanism to enable expansion and contraction. As can be seen by the heavy wear, the prosthesis shown in Picture 2 was used the most. Both were produced in such a way as to make it possible to walk easily and have been recognized as artificial legs of the A.A. Marks Company. Pictures 4 and 5 show prostheses made of wood covered with leather, without toes, and a knee joint that moves with difficulty. They are clearly different from the other prostheses. There are many similarities to the "Imperial Prostheses" bestowed by the Emperor at the time of the Sino-Japanese War. "Imperial Prostheses" were bestowed from the time of the Sino-Japanese War, but
were not used very much. A survey taken in 1913 showed that 11.5% used them all the time and that 4.5% used them sometimes (Table 1)\(^2\). As this research has shown, the 5 prostheses of Okuma are valuable materials for the study of the development of prostheses in Japan.

Okuma underwent surgery twice for the amputation of his thigh. He had only one leg, but he returned to lead a regular life in society using his artificial leg and a cane. He advocated the theory that life should last 125 years and lived a very regimented life. He made efforts to wake up early, and made a daily routine of sawing wood to strengthen his upper body and taking a bath to improve his circulation. He changed his lifestyle to a more Western one to accommodate his artificial leg (e.g. sitting on chairs, rather than on the floor), made sure to get the right amount of exercise, took special care to keep the end of the amputated leg warm and worked at making sure his blood circulated to all parts of his body. It was said that Okuma's health was largely due to his routine of taking a bath. He was always careful of his health, but he had five rules of his own regarding how to live a long life, taking special note of his mental health. The five rules were "never get angry, never complain, never look back at the past, put your hopes in the future, and do good for others." He suffered from gallstones late in life. He died in 1922 at the age of 84 from a malignant tumor of the prostate and atrophic gastritis.

The Western type of artificial leg was impractical for the general population to use in Japan at the time with regard to lifestyle and price, but it had a great influence on the manufacturers of prostheses\(^2\).\(^2\).

3. Life with an artificial leg · Yuichi Suzuki

Yuichi Suzuki (1872-1921) sprained the joint in his right leg at a sporting event in 1888. Due to suppuration, one third of his lower right thigh was amputated by Dr. Susumu Sato. His first artificial leg was made by the prosthetic maker Ishidaijubei Enshuya located in front of Asakusa Temple in Tokyo. However, it did not work well and it was difficult to walk on. Then one day in Asakusa Park, he saw a boy performing tricks with bamboo sticks tied to his heels. He realized that with practice, he too could learn to walk, and with a few months of diligent practice on his artificial leg, he learned to walk.

It was at the time of the Sino-Japanese War, so Yuichi and his friend paid visits to injured soldiers at Army Hospitals all over. When he could get permission, he showed the army doctors and injured soldiers his stump and demonstrated walking with his artificial leg. There were very few army doctors who had ever seen or heard of walking on an artificial leg. The doctors were very impressed and the soldiers took hope. Yuichi continued on and tried walking for long distances on mountain roads. He practiced walking and worked on the practicality and durability of his artificial leg. He visited the injured soldiers and prisoners of the Russo-Japanese War at army hospitals all over. He held practice sessions for amputees to ride bicycles and recommended horseback riding. Suzuki's various activities led to his mastery of confident walking on his artificial leg. His example provided a stimulus to the as yet undeveloped science of prosthetic manufacture for the reconsideration of methods of making artificial legs and to users of artificial legs to further improve their walking. In terms of enlightenment, Yuichi's two successful climbs of Mt. Fuji and the book entitled "On Artificial Arms and Legs" which was published in 1902 received much public response. He had a great effect on and greatly affected users of prosthetic devices, makers of prosthetic devices and people in society.

Suzuki next put his mind to the methods of production of artificial legs. He worked incessantly with shoesops and blacksmiths to find the artificial leg that was best for him. He had many legs made for him which formed a large pile in his family's storehouse.\(^2\)\(^4\) It was not the norm at the time for makers of prosthetics to fit their products to the patient directly. Rather, they were introduced to their customers through third party shops, making it difficult to match the artificial leg to the individual who would use it. Yuichi ordered his prostheses directly from the manufacturers and wouldn't give in until he made sure they complied to his demands. He maintained that artificial arms and legs should be made to fit the body and movements of the user. He set up his own factory specializing in prosthetic devices and worked on improving the process. As a result of his efforts, he developed an artificial leg called the "37th Year Model." It was not like previous rigid wood models, but could expand and contract, making it possible to sit on the floor, Japanese style, for long periods. It was possible to wear high-soled Japanese clogs and to walk without a cane, resulting in great satisfaction by the users of his prostheses. He established the Japan Prosthetic Manufacturing Company in 1918. During the Sino-Japanese War, his company was recognized by the
Imperial Household as a prosthetics maker and received orders from the Imperial Army under the patronage of the government 25).

III Discussion

The foundations of modern Japan were built in the Meiji Period. It was during this time that techniques of amputation developed. Artificial arms and legs for amputees, in other words, prostheses, were not well developed early on, and each person had to improvise for himself. But prostheses were necessary for disabled people with amputations to live a full and functional life, to work and be independent. The development of prostheses in the Meiji Era can be divided into three phases: the introduction of prosthetic devices from the West, the formation of Japanese style prosthetic devices ("Imperial Prostheses"), and functional prostheses created from the lives of ordinary people 28-31).

The use of Western prosthetic devices was limited to people with a high profile in society. The devices were imported and enabled such people to take advantage of the most advanced prosthetics of the day. Prosthetic manufacturers in Japan then used these imported prosthetic devices as models for their own versions. However, the artificial legs based on imported models were not well adapted to Japanese, both from the point of view of price and lifestyle. But ordinary people with disabilities struggled to live with the artificial legs available to them and formed a small support circle. The prosthesis of Tanosuke Sawamura, the first to be made in Japan, was made by a doll maker. It was pleasing to the eye and took root as the Japanese style prosthetic. It was a prosthetic unique to Japan and was bestowed as an Imperial gift on soldiers who had had limbs amputated due to war. Only a small proportion of people actually used the Imperial prostheses: 11.5% usually, and 4.5% sometimes. The Imperial prostheses could not actually be used as they lacked in functionality, but as Imperial gifts, weight was placed on form, making it a decorative prosthetic for display. It was a badge of honor, given to those who had sacrificed for their country, and was something to display where people would see it in the house, so respect would be paid by those who saw it. It was not something the amputees could actually use to walk, but it had value as psychological rehabilitation.

Yuichi Suzuki, himself an amputee, stressed the importance of function over form. But the manufacture of artificial legs in Japan continued to place importance on form, and people continued to think that the person should adapt to the artificial leg and not vice versa. There was not much involvement of the medical field in the manufacture of prosthetic devices in the Meiji Period. There were many doctors in the army who saw an artificial leg for the first time at the demonstration by Yuichi Suzuki. They were greatly moved, resulting in a period of the blossoming of prosthetic research. Suzuki worked to spread the idea of prosthetics, climbing Mt. Fuji with his, and in addition to showing how functional prosthetics could be, gave hope and courage to other amputees. Prosthetic devices, with both form and function, became essential for amputees to live their lives as full members of society.

IV Conclusions

This research was carried out to clarify the process of the development of prostheses in the Meiji Era which remained uncovered from previous studies through three case studies.

The following points were clarified by this research.

1. A classification of the historical development of prosthetic devices in Japan was made.
2. Five artificial legs used by Shigenobu Okuma were discovered, and the form and manufacturers of each were found.
3. The history of the development of prosthetic devices in Japan was divided into three categories: the introduction of prosthetic devices from the West, the formation of Japanese style prosthetics (the bestowal of "Imperial Prosthetics"), and the proliferation of functional prosthetics.
4. The process by which Japanese style prosthetics ("Imperial Prosthetics") came to be produced and how they were used was explained. The importance of maintaining functionality, form and economy in prosthetic devices, while enabling movement of the knee joint to support a Japanese lifestyle, was pointed out.

We are left with the tasks of confirming the need for prosthetic strategies to deal with the Japanese lifestyle,
to realize the history of support for amputees so we can better support the lives of people who use prosthetic devices, and to continue on with this type of research.

I express deep appreciation to all who helped in this research.

References

4. Takechi, Hideo. Gishi no rekishi (3) (History of prosthetics (3)). Igaku no ayumi. 1975; 93(10): 549-552.
5. Takechi, Hideo. Teashi no fujiyu na hito wo dou ayunde kita ka. (History of people with disabilities in their arms or legs.) First printing, Tokyo: Ishiyaku Shuppan, 1981.
24. Ogwara, Ichiyou. Gishusoku no hanashi (About artificial arms and legs). First printing, Kyoto:


29. Rikugunsho Henshu. Meiji 37, 8 nen Seneki Rikugunseishi, 1905: 7 kan: 281
