

History of prostheses and orthoses in Japan

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Abstract

Until the first contact with European civilization in 1543, prostheses and orthoses were not seen in Japanese medical history. Some physicians and surgeons who studied medicine in the Dutch language understood about prostheses and orthoses before the opening of the country in 1868.

From 1868 to the end of World War II (1945), prostheses and orthoses were influenced by German orthopaedic surgery. From the latter half of the 1960s the research and development of these have been advanced, because of the establishment of a domestic rehabilitation system, international cultural exchange and economic development.

The first contact with European medicine and surgery

While Japanese medicine and surgery had been influenced by China from ancient times, it was not until 1543 that the first Japanese contact with European civilization took place. This was when a Portuguese ship was driven ashore in Tanegashima, a southern Japanese island. It was at this meeting that guns were also first introduced into Japan.

Looking globally, 1543 was the year Vesalius published his anatomical book and the Copernican system was introduced. In the history of Japanese culture 1543 is also one of the most important years.

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After this many Christian missionaries, such as Francis Xavier, introduced European science into Japan. However, from 1639, the Japanese government forbade religious, cultural and commercial exchanges with European countries, due to their anxiety about the propagation of Christianity. Such exchanges were only allowed with China and the Netherlands. Japan's isolation then continued for two and a half centuries. Thus, Japan had already been introduced to European medicine and surgery through the Dutch edition of French, English and German medical books before the opening of the country in 1868 when the Meiji revolution broke out.

Earlier, a very curious high officer of the Japanese government, M. Inoue (1585-1661) had been interested in prostheses. He ordered both an upper and lower extremity prosthesis made of iron from a Dutch physician who was attached to the Dutch trade office in Nagasaki. However, when the physician showed him how to use the prostheses, he was so disappointed with their poor function that he did not pay the cost of 500 Guilders. This story was recorded in the 1656 Dutch Trade Office diary, making M. Inoue the first Japanese to see prostheses in Japan.

The 1649 Dutch edition of Ambroise Paré's complete works was partially translated into Japanese in 1706 by a famous physician, Chinzan Narabayashi (1648-1711).

However, no figures of prostheses or orthoses were seen in the Japanese translation, maybe due to his lack of knowledge about these.

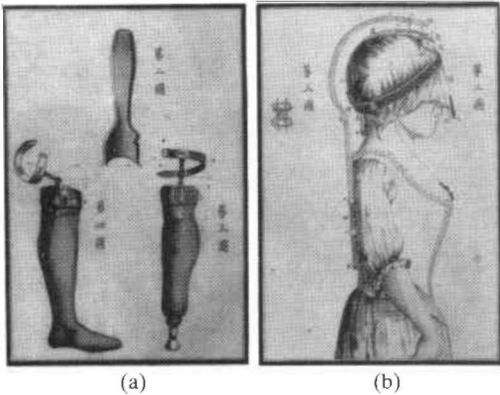


Fig. 1. Figures in Japanese translation of Plenk's book (1782)
 (a) Charles White's below-knee prosthesis.
 (b) Le Vacher's scoliosis brace.

The Dutch edition of *Institutiones Chirurgicae* by the German surgeon Lorenz Heister (1683–1758) was also translated into Japanese by H. Sugita (1763–1833) and G. Ohtsuki (1757–1827). The translation was mainly of the chapters on bone and joint injuries and of amputation.

Although many figures of orthoses were seen in the original book, no figures of these were observed in the translation. R. Sugita (1786–1845) translated a Dutch edition of Plenk's surgical book into Japanese in 1782. J. J. Plenk (1738–1807) was a surgeon in Vienna. Although Sugita did not publish this Japanese edition, in his translation figures of the Charles White's below-knee prosthesis and Le Vacher's scoliosis brace were observed (Fig. 1).

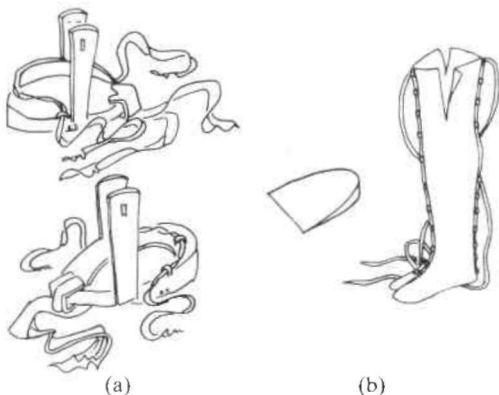


Fig. 2. Braces in Okuda's book of bone and joint injuries (1835)
 (a) correction brace for club foot.
 (b) heel wedge and boots for paralytic equinus.

M. Okuda (date of birth and death unknown) published a book in 1835 on the treatment of bone and joint injuries, in which three lower limb orthoses were seen. These details were probably taken from the original book by Lorenz Heister (Fig. 2).

K. Miyake (1817–1873) translated a Chinese edition of a surgical book by Hobson in 1858. B. Hobson (1816–1873) was an English surgeon engaged in missionary work in China, who published his book in 1857 in Shanghai. In Miyake's translation a figure of a wooden below-knee prosthesis was seen (Fig. 3).

Introduction of Palmer's prosthesis and the era of the Meiji Revolution

After a shipwreck in 1850, Joseph Hico (1837–1897) drifted for about 50 days before being rescued by an American ship. He was taken to the United States where he was educated. After his return to Japan he wrote a story about drifting in which he made note of a Palmer's prosthesis seen in the United States. He described how, in the United States leg amputation was performed for a man suffering from a gunshot wound and gangrene of his leg.



Fig. 3. Wooden below-knee prosthesis in Japanese translation of Hobson's book.

After wound healing an artificial leg was provided, enabling him to walk again almost as well as healthy people. Although usually older style artificial legs from Europe were used, he noted that the new Palmer's prosthesis was better, and because of the excellent function of the prosthesis. He showed a figure of it in his book (Fig. 4). S. Ito (1825-1880) translated an operating manual of an American electrotherapeutic machine in 1867, at the end of which was a translation of an advertisement for a Palmer's prosthesis.

From these records, it is probable that Japanese physicians and surgeons who studied medicine in the Dutch language understood the fundamentals of prostheses and orthoses before Meiji Revolution (1868).

In 1867 a famous Kabuki actor, Tanosuke Sawamura III (1845-1878), had his left lower leg amputated by an American surgeon, J. C. Hepburn (1815-1911), who was a missionary surgeon living in Yokohama at that time. At first a puppet-maker, Kiyozo Matsumoto made a below-knee prosthesis, however no adequate

socket fitting was available. The following year he had an American below-knee prosthesis from the Selpho Company and appeared again on stage. According to the description he was the first Japanese amputee to use the prosthesis (Fig. 5).

In 1872 the Academy for the Japanese Military Surgeons imported several prostheses from the Netherlands, which were used for medical education (Fig. 6). Although there were records of many war amputees from the 1877 civil war (Seinan War), little was known about any prosthetic service.

In 1986 a below-knee prosthesis was found in an old tomb in the Kagoshima Prefecture. It was a conventional below-knee prosthesis, with a bronze socket, and single axis ankle joint and toes, as well as a thigh corset. Although according to its inscription the tomb was built in 1818, it is questionable whether the prosthesis was made before 1818. Since there were a lot of defeated anti-government soldiers in the civil war in Kagoshima Prefecture, the prosthesis is considered to have been used secretly by one of

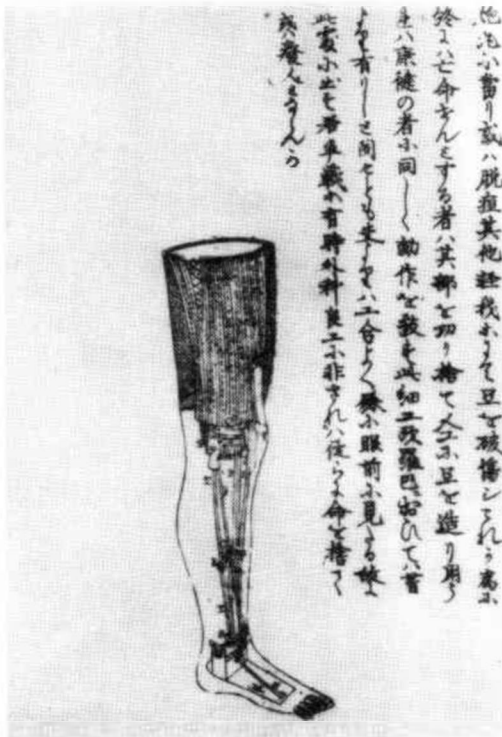


Fig. 4. Palmer's above-knee prosthesis in the story of drifting by Joseph Hico.



Fig. 5. Prosthetic fitting for Tanosuke Sawamura III (1867).

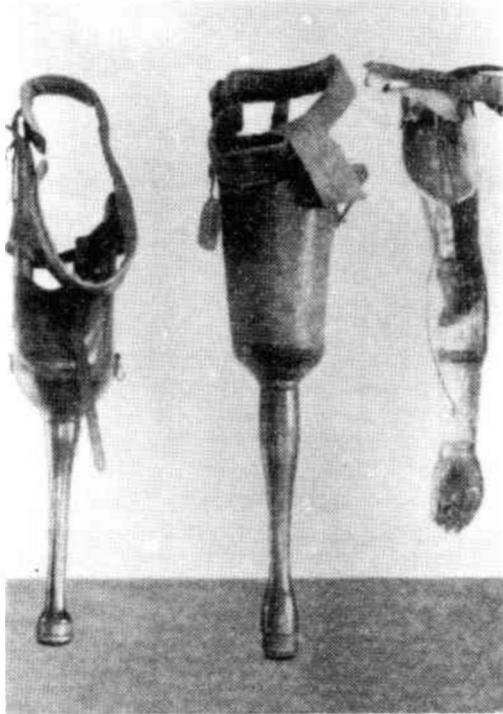


Fig. 6. Prosthesis imported from the Netherlands (1872).

these amputees. This is the oldest prosthesis in Japan (Fig. 7).

A French painter, Bigot, who was in Japan from 1882 to 1899 to study Japanese painting, drew a lot of caricatures about Japanese life, in which prostheses are seen (Fig. 8).

The Russo-Japanese War and World War II

During the 1904–1905 Russo-Japanese War, the Japanese army carried out procedures to produce a prosthesis for an end weight-bearing

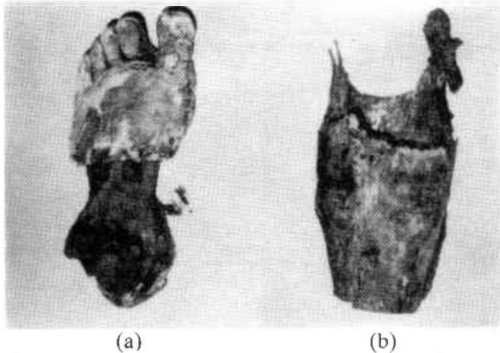


Fig. 7. Below-knee prosthesis found in an old tomb
(a) foot.
(b) socket.

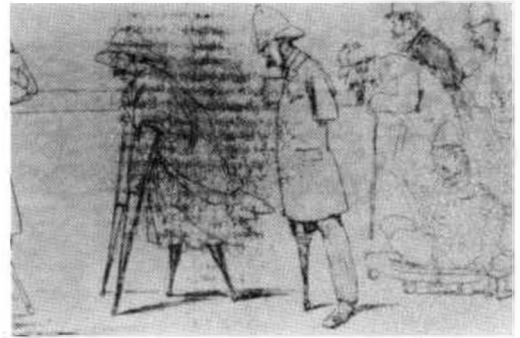


Fig. 8. Caricature by French painter, Bigot "Victim of terrorism".

stump, reported by the German surgeon, Hirsch, in 1900. The method was used continuously in Japan until the end of World War II. The Japanese army also developed an upper limb prosthesis during the war, designed by General Nogai, who was very famous because of the capture of Port Arthur. In 1911 the prosthesis was demonstrated by the Japanese



Fig. 9. Upper limb prosthesis designed by General Nogai (1905).

army at the International Hygiene Exhibition in Dresden. Although the precise structure of the prosthesis was described, little is known about its practical use (Fig. 9).

In 1887, the first prosthetic workshop was established by Isematsu Okumura, a dental prosthetist and merchant of medical instruments in Osaka.

The first monograph on prostheses was published in 1902 by Yuichi Suzuki, a right below-knee amputee, who became a prosthetist later, establishing a workshop in Tokyo. The monograph, although not scientific, is comprehensive.

While prostheses and rehabilitation of amputees advanced markedly in Europe and the United States during World War I, few were seen in Japan. However, in 1919 Japan accepted many Czech war amputees who had been engaged in the civil war following the Russian Revolution in Siberia, and they were provided with prostheses by the Japanese government.

As to orthoses, the Hessing-type construction consisting of upper and lower limb braces made of steel and leather, and corsets made of celluloid and leather were popular in Japan until the end of World War II.

From World War II to the present

During World War II the Japanese army developed two kinds of prostheses. One was a lower limb prosthesis named "Iron Leg", which was very suitable for farmers, consisting of an aluminium plug fit socket, locked knee and patten or Dollinger's foot (Fig. 10). The other was a working arm similar to the Tannenberg Arm of Schlesinger (Fig. 11). The ideas at that time were based upon the prosthetic classics, "Kunstliche Glieder" by Hermann Gocht and "Ersatzglieder und Arbeitshilfen" by Schlesinger *et al.*

Due to the shortage of raw materials following World War II, it was very difficult for many amputees and disabled to get prostheses or orthoses. During this period a very simple



Fig. 10. Above-knee prosthesis for heavy workers, Japanese Military (1938).



Fig. 11. Working arm, Japanese Military (1938).

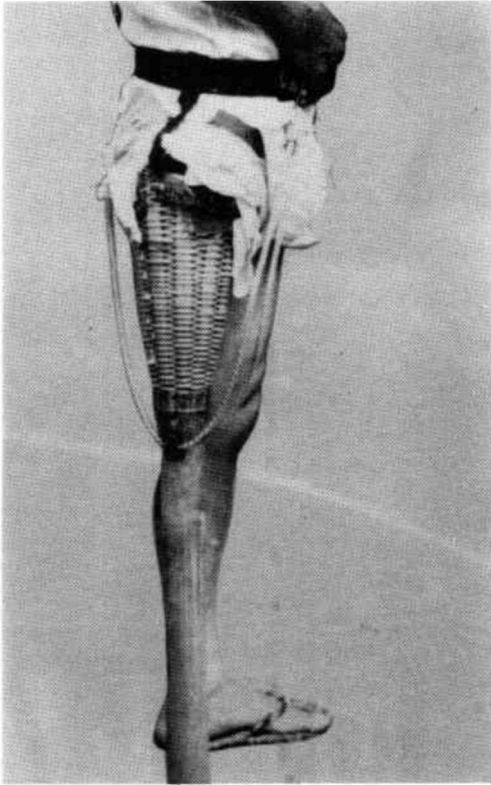


Fig. 12. Above-knee prosthesis made of bamboo (1947).

self-made lower limb prosthesis was seen in the rural areas of Japan, which had a bamboo basket socket and a bamboo pylon (Fig. 12).

As the rehabilitation system, international cultural exchange and economic status developed, Japanese prostheses and orthoses gradually improved. There has been much information from overseas about the quadrilateral socket, patellar-tendon bearing prosthesis, functional and electric arm and other devices. The quadrilateral socket was

introduced by a United Nations instructor in 1955. From the latter half of the 1960s, research and development has taken place in myoelectric arms and endo-skeletal prostheses. There has been standardization of components, and the development of education systems for physicians and surgeons. The qualification of prosthetists and orthotists and improvements in the limb fitting service have occurred.

These efforts encouraged the Japanese members of ISPO to offer to host the V World Congress in Japan. In November 1989 the V World Congress of ISPO was held in Kobe, Japan, the first time this Congress had been held in Asia.

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