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# The iron hand from Slovenia

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**Abstract**

The iron hand prosthesis now in the custody of the Rehabilitation Institute Ljubljana, was excavated some 80 years ago in the ruins of the Vransko castle. The hand, its form and function are described. It was manufactured somewhere in Europe between the years 1500–1650. The owner, probably one of the local nobles, has remained unknown.

## Introduction

In 1907 an ancient prosthesis was found in a walled-in niche while pulling down the old castle at Vransko (Fig. 1). No bones or weapons were found beside it (Stracker, 1917). It accidently found its way into a private collection of antiquities owned by J. Sadnikar, a veterinary surgeon from Kamnik, and from there to the Rehabilitation Institute of Ljubljana.

A search has been conducted for the original owner of the prosthesis among the feudal lords in the neighbourhood of Vransko where there are a number of castles (Orožen, 1880).

The search, however, was futile; no clues or records could be found in the local chronicles. The nearest church archives were burned during the second World War, whereas the castles themselves were pillaged during the peasant uprisings in 1635 and 1650.

## Amputation and stump

From a study of the prosthesis, Grobelnik (1990) believes that the amputation probably occurred as follows: the cut started in the middle of the first thumb phalanx, proceeded to the upper third of the metacarpal index bone, and then passed obliquely downwards through the other metacarpal bones to the pisiform axis of the right hand. The bleeding could not have been substantial and the injured man survived the accident. The resulting stump was suitable for the wearing of the iron prosthesis. The wrist remained movable, the thumb stump fitting well into the prosthesis and providing at least a partial control over it.

The amputation was probably caused by a sword while the knight's hand was closed into a fist, possibly holding reins, a spear or a flag pole.

The armourer who manufactured this prothesis quite ingeniously profited from the shape of the stump by shifting the entire mechanism of the prosthesis to its lateral area, thus gaining room for the stump of the thumb.

The amputee probably wrapped the stump into a piece of cloth or a bandage. He must have made good use of the prosthesis because the bandage thoroughly soaked with sweat


Fig. 1. Vransko, the place where the iron hand was found.

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Fig. 2. The iron hand, in opened position.

Fig. 3. The iron hand, in closed position.

would be the cause of the verdigris that can even now be observed in the prosthetic socket.

**Structure of the prosthesis**

The prosthesis, weighing 795 g, was made to replace a male right hand (Figs. 2 and 3). It roughly imitates the shape of the human hand. The palm storing the mechanism is somewhat larger. Compared to the palm, the fingers are thinner and semiflexed in the 1st and 2nd interphalangeal joints. The manufacturer went so far as to indicate the nails.

The thumb is shorter, rigid, and placed in opposition to the palm, which is most important for function. It enables a cylindrical grasp which would have made it possible for the amputee to hold a sword, a spear, reins, as well as a cup (then made of tin), and tools (Fig. 4).

The surface of the prosthesis is somewhat rough, the rust giving it a brownish colour. In the palm below the 4th and 5th finger, on the dorsum of the hand below the 4th finger, and on the thumb it is slightly corroded (perhaps from use). On the inside, in the area of the socket some verdigris can be noticed.

A longitudinal embossment runs along the middle of the palm, most probably facilitating a better grasp. In the middle of the dorsum a button-powered lever locks and unlocks the mechanism for moving the fingers.

On the volar side of the prosthesis a perforated hinged joint seems to have served to fasten possibly a leather butt onto the forearm. The material of which the butt was actually made and the way in which it was adjusted onto the forearm can only be guessed at. It might have been fixed in such a way as to facilitate mobility of the hand in the wrist, thus

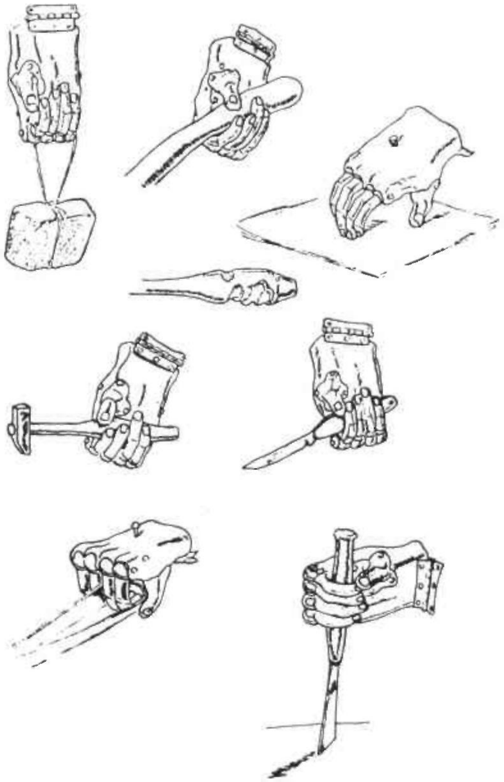

Fig. 4. Possibilities of the use of the hand from Vransko.

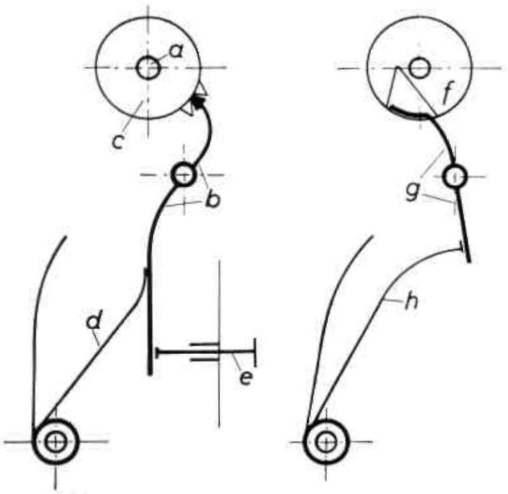


Fig. 5. Function of blocking mechanism.
The fingers being contracted around axis "a", the tip of lever "b" engages in the tooth on joint "c". The pressure of spring "d" prevents the sliding of the lever tip from the groove. By pushing button "e" on the dorsum of the prosthesis the lever is released and the fingers spring to the extended position.
As for the reverse mechanism the finger joint is provided with wheel "f" which is exposed to the action of lever "g". When the fingers contract, the wheel turns lever "g" around, compressing spring "h". Once the blocking mechanism is released, the spring presses the lever onto the wheel, and the fingers return to the initial position.

contributing to a better function of the prosthesis.

The fingers (the thumb is rigid) move in pairs in three steps but not coming into full contact with the tip of the thumb and the palm of the prosthesis.

**Functioning of the mechanism**

Even today the mechanism functions faultlessly. The wear of the teeth suggests that the prosthesis was well used. The mechanism consists of springs, cogwheels, and crank drives by which the fingers can be passively contracted or extended.

The mechanism fulfils two functions (Fig. 5):

- it stops the fingers in a desired contracted position in one of three steps,
- it releases the crank drives to let the fingers return to the initial position.

On the margin of the palm where the joint appears in a normal human hand, hinges are positioned. It is now hard to say what specific purpose the hinges were intended for but the rest of the construction seems to indicate that the designer of this iron hand also tackled the problem of the mobility of the hand in relation to the forearm.

At first sight such a metal hand might seem easy to make. However, a close study of the finger-moving mechanism shows that the problem is all but simple. It is similar (Fig. 6) to the original drawing of Paré (1840).

The iron sheet (approximately 1 mm) seems to have been made of two layers rolled together in a hot state or else "welded" together by forging.

The hand is made of several pieces joined by means of rivets. The holes for the rivets were pierced in a hot state and cold rivets then driven in. The holes then contracted on cooling, thus tightly gripping the rivets. It is possible that the rivet shank was notched to reduce the possibility of becoming loose.

A metallographic analysis of the sample (Pelhan, 1972) shows that the material of the hand is soft iron with a high content of oxidizing slag inçlusions. The basic structure of soft iron is pratically free of carbon. As obvious from the metallographic specimens, the material used in manufacturing the prosthesis was either processed steel or soft iron made by carbon elimination. In either case the iron was forged

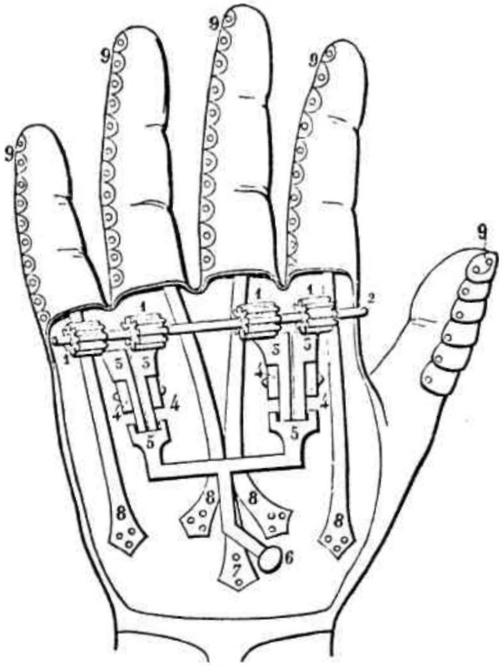

Fig. 6. Scheme of the artificial hand—from Paré 1840.

or rolled so as to remove the largest possible quantity of slag.

**Discussion and conclusion**

The noblemen of those times doubtlessly felt ashamed of being maimed. They tried to camouflage their condition as best they could. At the same time they wanted the aid to serve them in such vital activities as eating, drinking, use of weapons, and riding. The question is who in fact manufactured these prostheses. It could have been manufacturers of cuirasses, well trained as to technical construction, armourers or, to cite Paré (1840) with respect to "Le Petit Lorraine", locksmiths.

It would be interesting to know when individual prostheses were made. It is possible to fix the period of Gotz's hand (1505–1508); we also know one of the manufacturers by name, one "Le Petit Lorraine". These two hands and the one from Ruppin probably served as models to all other manufacturers, which is deduced from the fact that their technical solutions resemble one another, even though some are rather simple and others more sophisticated. Gotz's hand, however, represents the apogee of the technical knowledge and skill of its time both in its appearance and the principles of the finger-moving mechanism. It is not improbable (Putti, 1924) that all of these hands were invented by the same man or, at least follow the same basic idea that led several inventors to similar final products.

The advantage of the above hand over the others lies in its having a strong and immobile thumb placed in opposition to the palm. Such a thumb is optimal, offering firm support to the other fingers. A mobile thumb would of course come closer to a normal hand but it would require an additional mechanism, which implies further complications in its functioning which is already quite complicated.

The Slovenian hand could not have a mobile thumb because of the form of the stump. A most useful thumb stump was preserved as a result of which the mechanism had to be shifted to the lateral area of the prosthesis. The portion of the thumb that remained intact and a moveable wrist must have contributed a lot to the effective application of the prosthesis.

In his study on the iron hand, Stracker (1917) expressed doubts as to the presumption that the prosthesis could only have served a knight. In his belief it dates back to the 17th century. According to his study, its owner used it also for various other menial i.e. "unknightly" tasks.

We cannot but disagree with his arguments since the then "working man" would neither have the opportunity nor the money to purchase it, and in fact had no need for such a hand. We therefore insist on the presumption that the prosthesis belonged to a nobleman who must have lived some time between 1500 and 1635 when the castles of the Vransko area were under intense attack by robbers.

## REFERENCES


Grobelnik S (1990). The old iron hand of Vransko. *Zdrav vest,* **59**, 269–72.

Orožen I (1880). Das Bisthum und die Diezoese in Cilli. Das Dekanat Bresslau, IV. Teil. J Rafatsch Cilli.

Paré A (1840). Oeuvres complettes d'Ambroise Paré./edited by J-F Malgaigne.—Paris: Bailliere 1840–1841.

Pelhan C (1972). Metallurgical analysis of the iron prostheses. University of Ljubljana, Institute of Metallurgy.

Putti V (1924). Prostesi antiche. La chirurgia di organi di movimento. Vol.IX, fasc. 4–5. p495–526.

Stracker O (1917). Eine alte eiserne Hand. Die Technik füer die Kriegsinv. ZV 10.