

# Simple thumb prosthesis: a cheap and useful alternative to expensive and complex solutions

Andrzej Żyluk<sup>A</sup>✉, Agnieszka Mazur-Grzesiuk

Pomeranian Medical University in Szczecin, Department of General and Hand Surgery, Unii Lubelskiej 1, 71-252 Szczecin, Poland

<sup>A</sup>ORCID: 0000-0002-8299-4525

✉ azyluk@hotmail.com

## ABSTRACT

Traumatic or oncologic amputation of the digit (digits) is fairly common injury affecting the upper extremities. Amputation of the thumb causes significant disability as loss of the thumb accounts for 40% of the entire loss of hand function. In the case of thumb amputation, replantation is the best option, allowing almost full recovery of the hand function. However, for various reasons, replantation is not always possible or successful and in these cases other methods of thumb reconstruction such as toe-to-thumb transfer, lengthening procedures and index pollicization are considered. Other, reasonable option is use of various prostheses such as naked prostheses, vacuum-retained prostheses, or osteo-integrated prostheses. In the article we present a case of young man who underwent amputation of the distal phalanx of his thumb in right (dominant) hand due to malignant tumour. He had relatively long stump of the digit and he

found in the internet simple thumb prostheses made of rubber material, which were advertised as stage props and toys used to depict magic tricks. Total cost of the prosthesis was 20 PLN. He started using it in his daily activities and at work. At follow-up at 3 months after amputation the patient filled the DASH questionnaire and obtained score of 8 points, indicating normal hand function, both with and without the prosthesis. However, in the subscale "professional activity" the difference of 4 points appeared, favouring using a prosthesis. The patient reported also that use of prosthesis allows him to tie laces in his shoes, fasten clothes buttons and use scissors more efficiently. The patient believes that this simple prosthesis makes for him easier performing activities of daily living and professional work. **Keywords:** thumb amputation; digital prosthesis; hand function; hand cosmesis; the DASH questionnaire.

## INTRODUCTION

Traumatic or oncologic amputation of the digit (digits) is fairly common injury affecting the upper extremities [1]. There is a substantial difference between consequences of the thumb vs. finger amputation for overall hand function. The presence of the thumb is necessary for performing many activities such as lateral pinching, 3-fingers pinching and grasping. The thumb amputation accounts for 40% of the entire loss of hand function and is estimated to cover 80% of the activity required for holding, while long finger amputations accounts for about 10% of disability. The degree of dysfunction is significantly related to the length of the thumb's stump: it is much greater when thumb is amputated at the level of the metacarpophalangeal joint, while milder at the interphalangeal joint [1].

In the case of thumb amputation, replantation is the best option, allowing almost full recovery of the hand function [2, 3]. However, for various reasons, replantation is not always possible or successful. In these cases other, sophisticated methods of thumb reconstruction such as toe-to-thumb transfer, lengthening procedures and index pollicization are considered. These demanding operations are not available everywhere and not all patients are suitable to undergo this surgery. In these situations the patients adapt to their disability and learn to use their hand without a thumb.

A reasonable option for patients with relatively long stump of the thumb is use of various prostheses such as naked prostheses,

vacuum-retained prostheses, or more complex, osteo-integrated prostheses [4]. Silicone vacuum-retained prostheses are passive devices made of viscoelastic materials inserted on the stump and replicate the anatomical morphology of the hand, providing good cosmesis for distal amputations and stump protection.

There are several reports in the literature about prosthetic fitting of patients after thumb amputation. However, the authors did not find any similar paper in Polish literature, therefore we decided to present this case.

The objective of the study was to assess the clinical suitability of a simple thumb prostheses made of rubber material to improve hand function in patient after amputation of distal phalanx of the thumb.

## CASE REPORT

A 36 year-old man, an ambulance driver, sustained amputation of distal phalanx of the thumb of his right (dominant) hand, due to malignant neoplasm (myxofibrosarcoma). Amputation was performed with adequate margin of healthy tissue and the stump healed uneventfully. The patient returned to his original job 2 months after surgery. Although he was satisfied with the function of the hand without a fragment of the thumb, both in household activities and at work, he was looking for the possibility of prosthetic equipment. On the Internet, he found

simple thumb prostheses made of rubber material, which were advertised as stage props and toys used to depict magic tricks (Fig. 1). After importing these prostheses, he adjusted the size to the stump of his amputated thumb and began to use it. He quickly realized that the prosthesis allowed him to hide the missing part of his thumb, but also improved the function of his hand. So he started using it in his daily activities and at work. When he was in the author's clinic for a follow-up examination, he boasted about his idea and this inspired us to assess the function of the hand without a prosthesis and with a prosthesis. A standardized Disability of the Arm, Shoulder and Hand (DASH) questionnaire was used for assessment.



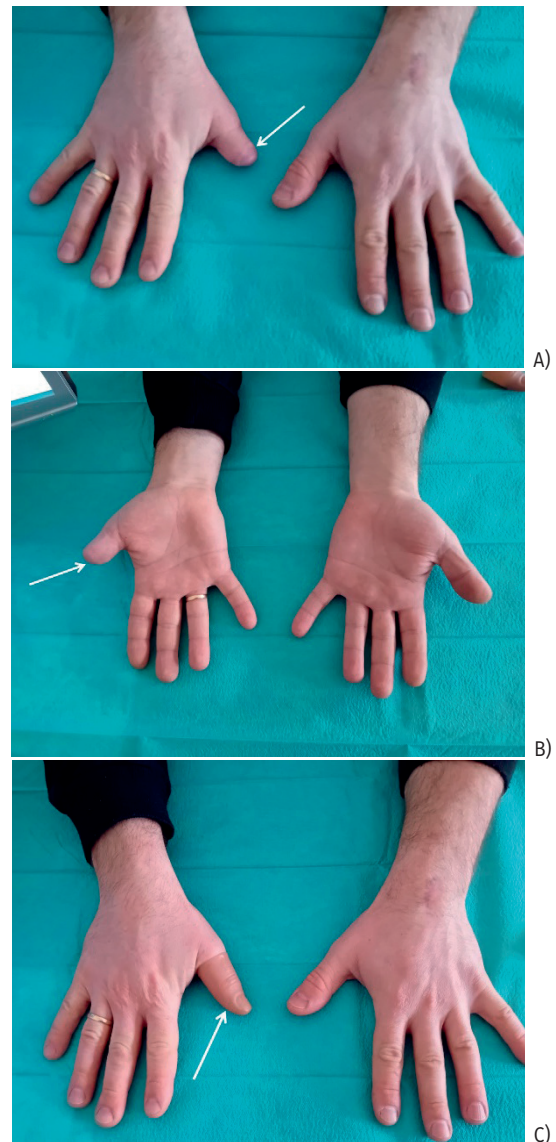
**FIGURE 1.** Various sizes of prostheses mentioned in the study

The scoring range of the questionnaire is from 0–100 points, with a range of 0–20 indicating good hand function and with the range of 0–10 – normal hand function. At follow-up at 3 months after amputation the DASH score obtained by the patient was 8 points, both with and without the prosthesis. However, in the subscale “professional activity” the difference of 4 points appeared, favouring using a prosthesis. Analyzing particular items of the questionnaire, we found that the patient declared slight problems with activities such as opening of the sealed jar and at heavy housework. He had also mild pain in the stump dependent on the change of weather. Except of items from the DASH questionnaire, the patient reported that use of prosthesis allows him to tie laces in his shoes, fasten clothes buttons and use scissors more efficiently. The patient believes that this simple prosthesis makes for him easier performing activities of daily living and professional work. He was very satisfied with its use and recommends it to other patients with thumb amputations. The patient's hand with and without thumb prosthesis is shown in Figure 2, whereas Figures 3–5 show daily activities performed with and without the prosthesis.

## DISCUSSION

The presented example of how a toy thumb prosthesis allowed a patient to improve the dexterity of his slightly disabled hand is interesting because of its simplicity and effectiveness, at a minimal cost. A single prosthesis in an online store costs 20 PLN, while aesthetic finger prostheses cost about 7000 PLN.

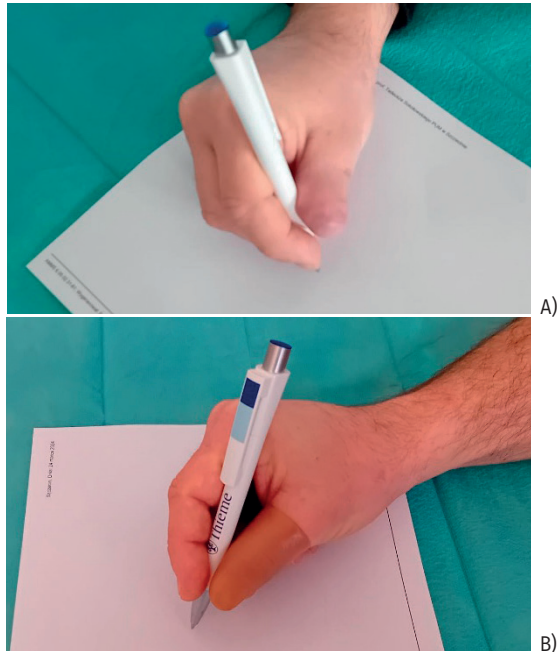
It is obvious that such professional aesthetic dentures look much nicer, but they will improve the function of the hand just as much as the one presented at work.



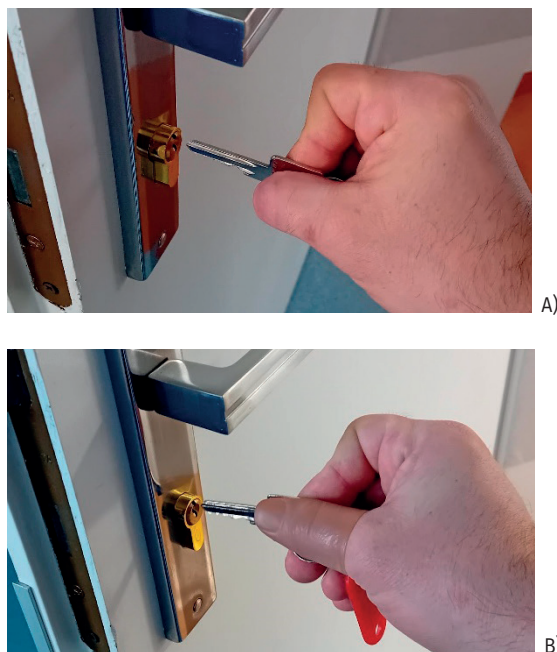
**FIGURE 2.** View of the patient's right hand with: A) partial amputation of the thumb (palmar side); B) partial amputation of the thumb (dorsal side); C) the prosthesis of the thumb

The introduction already mentions the possibilities of thumb reconstruction from own tissues (toe-to-thumb transfer, lengthening procedures, index pollicization). Another form of lengthening of amputated fingers are osseointegrated prostheses [5, 6]. The concept of osseointegration can be defined as a direct anchorage of an implant into skeleton of the stump which induces bone healing to the implant surface. After integration of the anchor with bone, the thumb prosthesis is placed on the principle of a snap mechanism. An advantage of this idea is emphasized such as the ability to sense vibrations and pressure in the amputated digit, defined as osseoperception. Li et al. reported results of prosthetic provision of 13 thumb stumps (at the level of metacarpal bone), of which number 7 patients were available in the follow-up at a mean of 9.5 years

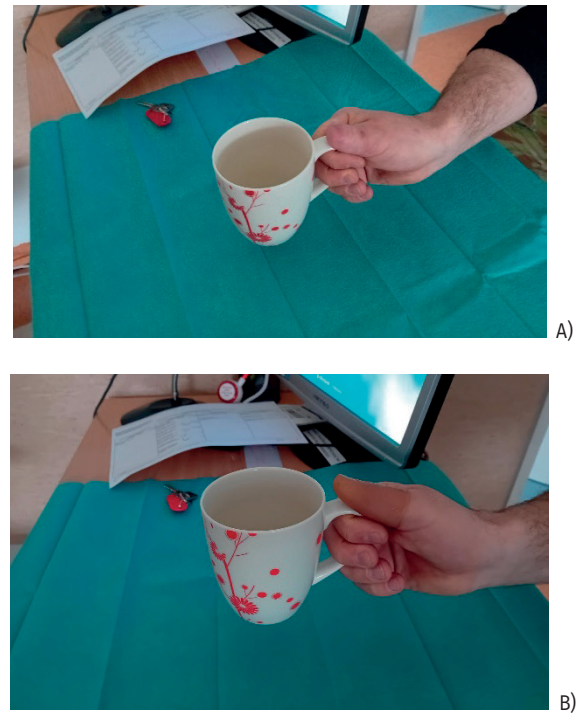
(range 6 months – 25 years). All 7 patients used their prostheses 7 days a week, 8–24 h a day. All patients had good osseoperception, grip strength was a mean of 28 kG (70% of the unaffected hand), key grip strength was 6 kG (67%) and hand function was 94% of the normal hand. The most common complications were mechanical failures necessitating changes of components and superficial infections. Five patients had no complications [7]. This solution has been known for many years, but it has not gained greater popularity, because it is associated with the risk of bone infection, loosening of the implant and because high costs [6].



**FIGURE 3.** Holding a pen while writing: A) without a prosthesis on the thumb; B) with the prosthesis on the thumb



**FIGURE 4.** Inserting the key into the lock: A) without a prosthesis on the thumb; B) with the prosthesis on the thumb



**FIGURE 5.** Holding the cup: A) without a prosthesis on the thumb; B) with the prosthesis on the thumb

Yet another alternative for prosthetic fitting for thumb amputees are vacuum-retained prostheses. These devices require a digital stump length greater than 1,5 cm which may not always be available. Despite recent improvements, frequently reported drawbacks of these prostheses include instability and low retention, lack of sensibility, excessive sweating and irritation of the skin if the stump. Long-term use of silicone vacuum prostheses has been reported to be between 64–97% which means a non-constant use of external prostheses in a great number of patients [8, 9, 10]. In contrast, Pereira et al. reported satisfactory results in a review of 30 patients fitted with vacuum-retained digital prostheses after a minimum follow-up time of 2 years [10]. The authors found that 22 (73%) used their prostheses daily and another 7 (23%) used them intermittently according to the occasion. Technical problems, such as loose fit and perspiration, resulted in 7 (23%) of the patients using the prostheses only occasionally. Results of this study demonstrated that digital vacuum-retained prostheses can alone or in conjunction with appropriate surgical reconstructions restore near normal appearance of injured hand, significantly improve damaged body image, and simultaneously improve physical capability. The authors emphasize that fitting a prosthesis goes beyond aesthetics [11].

## CONCLUSION

The case presented in the article may be helpful for patients with partial thumb amputations. Although most of them adapt well to a minor disability, using such a cheap and easily accessible prosthesis can improve their functioning at work and in everyday life.

## REFERENCES

---

1. Żyłuk A. Replantacje kończyny górnej. In: Żyłuk A, editor. *Chirurgia ręki*. Warszawa: Medipage; 2017. P. 657-78.
2. Atroshi I, Rosberg HE. Epidemiology of amputations and severe injuries of the hand. *Hand Clin* 2001;17:343-50.
3. Żyłuk A. Ten-year (2010–2019) activity report of the Replantation Service for hand amputations in Poland. *Handchir Mikrochir Plast Chir* 2023;55(1):41-6.
4. Heitmann C, Levin LS. Alternatives to thumb replantation. *Plast Reconstr Surg* 2002;110(6):1492-503.
5. Willy C, Krettek C. Transcutaneous osseointegrated prosthesis (TOP) after limb amputation : Status quo and perspectives. *Unfallchirurg* 2017;120(5):395-402.
6. Bregoli C, Biffi CA, Morellato K, Gruppioni E, Primavera M, Rampoldi M, et al. Osseo integrated metallic implants for finger amputees: a review of the literature. *Orthop Surg* 2022;14(6):1019-33.
7. Li Y, Kulbacka-Ortiz K, Caine-Winterberger K, Branemark R. Thumb amputations treated with osseointegrated percutaneous prostheses with up to 25 years of follow-up. *J Am Acad Orthop Surg Glob Res Rev* 2019;3(1):e097.
8. Dias Caldeira FI, Nascimento VA, da Silva Gasque KC, Haddad MF. Use of silicone finger prostheses in amputee patients: An integrative review. *J Indian Prosthodont Soc* 2021;21(4):339-47.
9. Pilley MJ, Quinton DN. Digital prostheses for single finger amputations. *J Hand Surg Br* 1999;24(5):539-41.
10. Pereira BP, Kour AK, Leow EL, Pho RW. Benefits and use of digital prostheses. *J Hand Surg Am* 1996;21(2):222-8.
11. Kuret Z, Burger H, Vidmar G, Maver T. Adjustment to finger amputation and silicone finger prosthesis use. *Disabil Rehabil* 2019;41:1307-12.