Abstract—This paper presents a robotic index finger prosthesis with the ability to bend and to adaptively grasp objects. The robotic finger mechanism is based on five-bar linkages with the torsion springs and mechanical limits to realize the under-actuation and self-adaptive grasping. The torsional springs and the mechanical limits are located between two lower links of five-bar linkages in each of proximal and middle phalanx and utilized to maintain the four-bar linkages form. When the PIP(proximal interphalangeal) joint is rotated, MP(metacarpophalangeal) and DIP(distal interphalangeal) joints of the robotic finger are rotated at the same time. When grasping objects, the artificial finger closely adapts to the shapes of objects pushing two lower links with the torsional springs. The finger amputees whose proximal phalanx of index is slipped can activate the PIP joint. Thus an artificial index finger can be controlled by using remaining stub of the amputees phalanx and the PIP joint without an additional actuator as if the finger of normal people does.

Until now, various robotic hands or fingers have been developed and are extensively used in a variety of areas. Several researchers have studied and developed artificial robotic fingers or hands for amputees nowadays. In [1], the under-actuated mechanism with the stackable four-bar linkages was proposed and controlled by using the EMG(electromyography) and a linear actuator for amputees who cannot activate MP joint themselves. And also, commercially available medical robotic finger(called X-finger) with one DOF under-actuated mechanism was introduced and controlled by the remaining proximal phalanx of amputees, without an actuator in [2]. However, an object-adaptable grasping was not considered in this robotic finger suitable for the bending motion. Figure 1 shows the initial position of the proposed finger mechanism and its part names. This mechanism is based on five-bar linkages. The torsional spring and the mechanical limit are located in the joint between two lower links of five-bar linkages in each of proximal and middle phalanx and utilized to maintain the four-bar linkages form so long as being pushed by objects. In other words, two lower links are structurally equivalent to the one virtual link. When an object pushes lower links, the angle between lower links as well as the length of the virtual link increase. And then the subsequent joints(PIP or DIP) are rotated according to the increase of virtual length.

Figure 2 shows one of the advantages of the proposed mechanism. Once the object is contacted with the proposed finger mechanism, the torsional spring is activated to make the subsequent joints contacted. Thus the proposed mechanism can grasp many kinds of arbitrary objects. The adaptive mechanism of prosthetic index finger for finger amputees is proposed by using five-bar linkages with the torsional springs and mechanical limits. The proposed mechanism has ability to basically perform flexor and extensor motion and to grasp an envelope of objects with different shape and size. Thus this robotic finger can be controlled by using the remaining proximal phalanx of amputees themselves, without using actuators.

However, we still have a future work. a problem to anchor on the palm remains. The robotic finger should be securely fixed somewhere. In order to overcome this weak point, the anchoring connector should be located around the wrist.

REFERENCES