The Changing World of Prosthetics in Halacha and Beyond

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Introduction

Recently, a *Kohen*, a Jewish priest, married into my family, which opened up a whole world of Jewish Law within my life that had been previously untouched. Specifically, the concept of a *mum*, a physical blemish that can disallow a *Kohen* from performing their holy service, fascinated me as a Pre-med student. What is considered a *Mum*, and can such a blemish ever be cured to a viable extent? On a separate note, my first cousin had to get his hand amputated only a short while ago due to a freak accident at his work, and is on his way to recovery. Naturally, these two separate conversations lead directly into the world of amputation and prosthesis–its past, present, and future. Furthermore, it is vital to explore the constantly updating realm of technology and its effect on how the concept of *mum* is seen through the lens of Halacha. The future of prosthetics lies at the heart of medical innovation, and is a vitally important subject to explore through a legal, scientific, and ethical lens.

To address the loss of a limb or amputation, prosthetic devices have been created as corrective measures. Historical records indicate that as early as 2700 BCE, prostheses were utilized. Initially, these prosthetic devices aimed to compensate for the absence of a limb, serving as substitutes and restoring a visually complete appearance for amputees. Gradually, advancements were made to enhance the capabilities and functionality of prosthetic devices. With the emergence of new materials and advancements in modern technology, realistic devices have been developed, offering greater mobility and improved functionality to individuals who have undergone amputations. These artificial limbs not only provide a sense of wholeness but also raise complex questions within Halacha regarding their classification. As technology continues to progress, the intricacies surrounding the categorization of prostheses as genuine limbs become even more intricate.

General Prosthetics Introduction

Prosthetics is a topic not only relevant to my life, but to the broader America as a whole. There are currently around 2.1 million amputees living in America, a number expected to double by the year 2050. Being that 185,000 people have amputations in America each year, there are around 300 to 500 amputations performed per day. Life as an amputee reaches beyond physical pain and medical complications, as there are economic ramifications as well. Lifetime healthcare

costs for people with limb loss in America is $509,275 compared to $361,200 for people without limb loss [1].

There is not one simple solution to helping the amputee community, as there are a wide variety of causes behind limb loss. Among the nearly 2 million people living with limb loss, the main causes are vascular disease (54%), including diabetes and peripheral arterial disease, trauma (45%), and cancer (less than 2%) [2]. Trauma is a wide-ranging category that includes victims of car accidents, workplace mishaps, and, more specifically, the 1,558 American military personnel who lost a limb as a result of the wars in Afghanistan and Iraq. On top of these possible causes during one's lifetime, there are also individuals born with limb loss (congenital limb deficiency).

Amputation is an even more significant health determinant outside of America. On a worldwide scale, around 100 million people need a prosthetic limb to replace an amputated arm or leg, or an orthotic device to support a damaged limb. Sadly, it's estimated that around 80 per cent of these people don't have access to these services, an issue particularly prevalent within low- and middle-income countries, leaving over 30 million people in need of prosthetic and orthotic devices [3]. The lack of resources combined with the physical and economic strain that goes hand-in-hand with limb loss often lead to poorer clinical coverage of patients within developing countries [2].

World History of Amputation

Prosthetic devices have been around for thousands of years dating all the way back to Ancient Egypt. In fact, the two earliest prosthetic limbs so far discovered have had ties to Ancient Egyptian culture. The first is a wooden toe found on a mummified body in the necropolis at Thebes-West in Cairo from around the time period of 950 B.C.E. [4]. This prosthetic toe found on a female mummy is made of wood and leather and is currently being held at the Egyptian Museum in Cairo. The other artifact is the Greville Chester toe currently kept in the British Museum. It is made of cartonnage, an ancient type of papier maché made with a mixture of linen, animal glue and tinted plaster, and dates back to around 600 B.C.E. Researchers have taken it upon themselves to study the validity and functionality of these prosthetic devices and have proved that these devices make walking in sandals significantly more comfortable and less painful, a useful function during the ancient lifestyle in Egypt [5].

Figure 1: Prosthetic toes from Egyptian Mummies, (950-600 B.C.E.) [4][5]

The next recorded instance of a prosthetic limb in history comes from around 450 B.C.E., around 500 years after the wooden toes of Cairo. The Greek historian Herodotus recorded how the prophet Hegesistratus of Elis was captured by the Spartan army and immediately condemned to death. Right before he was killed, Hegesistratos managed to steal a sword from a member of the Spartan army and cut off his foot in order to remove the chains holding him. He then "tunneled through the wall out of the way of the guards who kept watch over him, and so escaped." Herodotus continues to detail that after Hegesistratus's escape, "He had made himself a foot of wood." After the application of this prosthetic foot, the prophet hobbled around for over 30 miles, but apparently was never able to run quite fast enough, and eventually his enemies caught up with him, as Herodotus explains: "The enmity which he bore them brought him no good at the last, for they caught him at his divinations in Zacynthus and killed him." Roman culture is at the center of prosthetic innovation during these times. In 1858 Artifact findings of a copper and wood leg in Capri, Italy were tested and found to be from 300 BC era, validating this account (Fig. 2).

Figure 2: Roman lower-limb prosthesis (300 B.C.E) [23]

Aztec mythology describes Tezcatlipoca, the god with a prosthetic right foot made of black volcanic glass, which was believed to have existed as early as the 12th Century CE. Nevertheless, since these legends are part of ancient cultures' mythology, it is unclear whether they are historically accurate or if they were added later to these characters.

During the dark ages from 500 CE to 1500 CE, crude prostheses were developed for battle and concealing deformities, made of basic materials such as wood, metal, or leather. These included peg legs and hook hands, and even iron hands, manufactured by armor makers to replace the lost hands of knights in battle. The oldest surviving prosthetic limb is the "Alt-Ruppin" hand from the Renaissance period (14th - 15th Century CE), which is now located in the Stibbert Museum in Florence, Italy. The iron hand had a movable wrist, a rigid thumb, and two pairs of fingers that could move when the button on the base of the palm was pressed. The "Alt-Ruppin" hand marked the beginning of prosthetic limb advancements, leading to further developments in artificial hands and arms.

Continuing on to the early modern period of prosthetic limbs, there is, at the center, the French surgeon Ambroise Pare (1510–1590). In 1579 Pare published an entire catalog describing the different prosthetic limbs he created and fitted on his patients. According to Philippe Hernigou in the journal International Orthopedics, Pare intended these prosthetics to be used as functional limbs and not just stand-ins for aesthetic reasons: "When he designed legs, he gave them a mechanical knee that could be locked when standing and bent at will. He drew up preliminary sketches of an arm that could be bent with a pulley that mimicked arm muscles." His most innovative creation was the mechanical hand he invented; it "operated by catches and springs, [and] was worn by a French Army captain in battle." Apparently it worked so well that the captain was able to grip and release the reins of his horse (Fig. 3) [4].

Figure 3: Le Petit Lorrain. *Les oeuvres d'Ambroise Paré* 1633 [4]

Pare also created an above-knee prosthesis with a fixed equinus position, a locking knee, and a suspension harness, features still found in prosthetic legs today. Pieter Verduyn, a Dutch surgeon, improved on Pare's design and introduced the first non-locking, below-knee prosthesis in 1696, with external hinges and a leather cuff that bore weight to increase leg movement and improve gait.

Figure 4: Pare's drawing of his prosthetic leg design [24]

In 1800, James Potts of London designed an above-knee prosthesis with a wooden shank and socket, a steel knee joint, and an articulated foot controlled by catgut tendons from the knee to the ankle. Subsequently, in 1863, Dubois L. Parmelee patented a new lower limb prosthetic, a

mechanical foot with a molded socket that attached to the limb with atmospheric pressure, improving comfort and fit for the limb to prosthesis connection. In 1898, Dr. Giuliano Vanghetti of Italy invented an artificial arm that used kineplasty, whereby an amputee could use muscle contraction in their stump to power their prosthesis. Advances in medicine and prosthetic science at the end of the 19th century led to major innovations and breakthroughs in technology during the two world wars, leading to the modern era of prosthetics.

Figure 5: Prosthetic leg designed by James Potts of London, 1800 [24]

Modern Innovations in Prosthesis

In the midst of the 20th century, when much of the world was in political and cultural turmoil, the field of prosthetics changed drastically. Before these changes, upper and lower limb prosthetics were mainly defined as sockets, specifically the “plug fit” wooden socket, that would be carved and fastened to fit the remaining stump of the limb. The prosthesis would then be attached to this wooden socket, which was often lined with leather at that time to provide a level of cushioning [6].

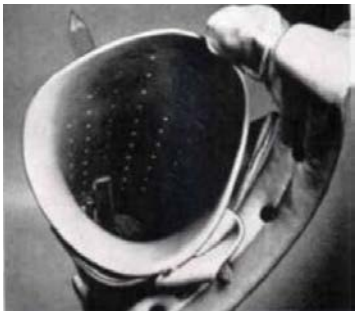

Figure 6: Conventional socket for “plug” Fit [6]

Then, in 1945, World War II was finally over, but peace came with a price: an untenable number of soldiers returned home from war with missing arms, legs, and other limbs. In addition to the many global programs introduced to help veterans in the post World War II era, the US National Academy of Sciences instituted the “Artificial Limb Program”, which began the movement to pursue organized research in the field of prosthesis. The research mainly focused on discovering how to make prosthetic devices more lifelike and functional through the introduction of new materials and surgical techniques, and the incorporation of the growing field of computer design. With the help of the “Artificial Limb Program”, the University of California at Berkeley successfully tested an above-knee suction-socket prosthesis in 1947 that attached to the stump without any suspension harness or band. This changed the previous format of leg prosthetics as it created a pressure-controlled vacuum in the socket of the prosthetic device instead of relying upon the transferral of weight into muscles around the thigh as in previous examples of leg prosthetics. This change gave more comfort to the amputee and allowed for a broader range of muscle control, preventing muscle atrophy at the site of attachment [7].

Further into the 20th century, Ysidro M. Martinez, an amputee himself, invented a new type of lower-limb prosthetic and received a patent for his design in 1975 [8]. He developed his limb to improve balance, facilitate acceleration and deceleration of the prosthetic limb, and reduce friction by utilizing lightweight technology and a high center of mass. Martinez’s efforts created a new period of advancing the state of prosthetic devices with a focus on providing a supreme level of comfort and an above average level of advanced functionality.

Over the past couple of decades, advancements in the field of prosthetic innovation have reached new heights. No longer is there one new invention made available for amputees, but the options are seemingly limitless. There are now a wide array of prosthetic devices ranging in

levels of comfort and functionality, allowing each patient to choose which specific device would work best for their current needs and overall situation. It is important to consider that technology is a constantly-adapting field and new models, styles, and capabilities are being added to prosthetic devices every single day.

Starting with upper limb prosthetic devices, there are many types of prosthesis available. There is passive prosthesis, prioritizing the appearance of the prosthetic over its functional capabilities. This type of prosthetic is tailored to an individual that doesn't require functionality in the upper extremities, and would rather have a "stop-gap" solution for the time being. Then there is the conventional/body powered prosthesis that is controlled by upper body movements, allowing for a wider range of action. Finally, there is the electrically-powered prosthesis, which capitalizes on motor controls to create the highest level of function within the arms and hands. A popular version of electrically-powered prosthesis is Myoelectric prostheses: "Myoelectric prostheses are powered by electric motors with an external power source. The joint movement of an upper limb prosthesis or orthosis (e.g., digits, hand, wrist, and/or elbow) is driven by microchip-processed electrical activity from the muscles of the remaining limb or limb stump." [9].

Lower limb prosthesis is a broader category as it contains two types of prosthetic devices: below-knee (BK) leg prosthesis and above-knee (AK) leg prosthesis. The choice of which style of device to purchase comes with three key considerations: a) the size and condition of the stump, its musculature and neuromuscular control; b) weight bearing ability of the limb, as well as the condition of the skin, joints, and vascular state; and c) amputees motivation and activity level [10]. Also, both of these utilize a variation of a socket, with the AK prosthetics including a knee and supportive frame for the socket, while the BK prosthetics are composed of a socket, pylon, and a foot.

Looking closer at the mechanics of BK Prosthesis, the aforementioned pylon distributes weight between the socket and the prosthetic foot functioning as the "leg" of the device. Like other types of prosthetic devices there are a range of pylons available for different types of activities that an amputee would want to complete. For more intense physical actions, a dynamic pylon could help reduce the shock traveling to other parts of the body during active sessions. Dynamic pylons actually contain a spring-like device that helps propel a runner forward during a race for example.

The variation in an AK prosthetic mainly exists in the type of knee an amputee chooses to wear. The main two types of mechanical knees are single-axis and polycentric knees [11]. The single-axis knee is a simple hinge-type knee that is lightweight, simplistic, cheap, and durable. However, a disadvantage with this type of knee is that the wearer needs to rely heavily on their own remaining muscle power in the limb to fully operate the prosthetic. Polycentric knees have multiple axes of rotation, ranging from four points of rotation to seven, with four points being the most common. The multiple axes create a high level of stability within the knee. Also, with the inclusion of pneumatic or hydraulic features, the patient will be able to vary their walking speed while maintaining stability [12] [13].

The last main category of AK prosthetics are computerized knees. These prosthetics contain a microprocessor chip that receives data from sensors located in the foot and knee joint. The data is then used to adjust the range of motion and extension in the knee corresponding to what the wearer needs at that exact moment. The quick adaptability of the computerized knee leads to a more natural gait, and lowers the amount of effort needed for walking. The technology is accessible, as most microprocessor chips can be accessed via a phone or computer to adjust to different activity modes. While the computerized knee helps the wearer to quickly adapt to different walking modes and speeds, this prosthetic is significantly more expensive, requires a battery charge, and can be damaged by weather-related conditions [14].

The advent of 3-D printing technology is another new technology that has brought about significant changes in the production and development of prosthetic limbs. Previously, prosthetic limbs were hand-crafted using plaster casts, melted plastic, and other raw materials in laboratories. With the aid of 3-D printing technology, prosthetists can now produce prosthetic limbs more accurately and rapidly than ever before, with minimal use of materials. Prosthetists can generate an electronic image of a prosthesis by scanning it or using computer technology to specify the design. The computer program sets the parameters for the 3D printer, which then produces the prosthetic device. As technology continues to advance and become more accessible, we can expect further improvements and applications. Recently, Northwell Health, in partnership with Eschen Prosthetic and Orthotic Laboratories and CPC (Composite Prototyping Center), developed the world's first 3D-printed amphibious prosthetic leg for swimmers in April of this year [15].

Finally, at the center of all modern innovation in the world of prosthesis is brain-computer interface (BCI). This technology enables the user to control their prosthetic limb through their thoughts, which are picked up by sensors on the skin or implanted in the brain. This interface allows for more intuitive and natural movement of the prosthetic limb, increasing the sense of embodiment and reducing the cognitive burden on the user. The brain-computer interface also offers the potential for sensory feedback, enabling the user to feel pressure, temperature, and other sensations through the prosthetic limb. In 2016, a team of experts led by Robert Gaunt, Ph.D., assistant professor of physical medicine and rehabilitation at Pitt, demonstrated for the first time ever in humans a technology that allows patients to experience the sensation of touch through a robotic arm that he controls with his brain [16]. With continued development and research, brain-computer interface technology has the potential to revolutionize the field of prosthesis, offering greater mobility, realistic functionality, and a more normalized quality of life for individuals with limb loss [17].

Amputation in the Bible and the Gemara

Due to the fact that there have been prosthetic devices in existence since around 950 BCE, it is no wonder that amputations and its accompanying technology have been relevant to Jewish History as well, being referenced even during Biblical times, and directly discussed during the times of the Talmud. The first reference to amputees in the bible is indirect and appears in the Midrashic interpretation of the Biblical text. After leaving the land of Egypt, a recently freed and new nation, the Jewish people wandered in the desert for 40 years on their ultimate journey to the land of Israel. At the beginning of this journey, Moses led the Jewish to the foot of Mount Sinai at the request of God. There the Jewish people were destined to receive the sacred Torah. The Midrash explains that before this occurred, God healed all of the physical defects amongst the Jeiwsh people, and that there were no amputees left among them (Midrash Tanchuma, Exodus 19:8). In the section of the Prophets, the tribes of Reuven and Shimon, notorious for their aggressive and violent traits, defeated a Canaanite king in battle, and immediately afterwards, they cut off his toes as a sign of retaliation (Judges 1:6). In the times of the Writings, another Midrash details how when the Jewish people were exiled to Babylon, they were forced to play music for the enjoyment of their captors. As a stand against this oppression

they chose to cut off their thumbs so they would not have to play music before Nebuchadnezzar and his army. (Midrash Tehillim, 137:4). This concept of self-mutilation comes up elsewhere in Jewish history with the story of Bar Kochva. Each of Bar Kochva's 200 soldiers cut off a finger as a test of their fortitude (Jerusalem Talmud - Taanit, 4:8).

Besides for cases of self-harm, amputation has appeared as a form of punishment throughout Jewish history as well. After Ish-Boshet was killed, King David commanded that those individuals responsible for the murder have their hands and feet cut off (II Samuel 4:12). There is also the tale of Yissachar from the village of Barkai. Yisaachar was a disgraced priest of the Jewish temple, and in order to show disrespect towards his service, he would cover his hands in silk wrapping to avoid getting them slightly dirty while working in the temple. In order to punish this vile behavior, the Hasmoneon king at the time ordered the amputation of Yissachar's hands, creating a sign for the other people of Israel to respect the work of G-d and his commandments (Pesachim 57a).

While amputation appears as a form of punishment committed by Jewish individuals in Jewish texts, it is never truly accepted as a recommended and proper form of retribution according to the Jewish law. In Exodus, the Torah seemingly permits the punishment of "A hand for a hand" (Exodus 21:24). In Deuteronomy, a case is described where two men are in a fight, and the wife of one of the individuals tries to save her husband accidentally harming the genitalia of her husband's attacker. The verse states "And you shall cut off her hand" (Deuteronomy 25:12). In reality, these biblical commandments are clarified as representing monetary forms of punishments in the Jewish Oral Law (*Bava Kama* 83b). While amputation is not directly used as a form of punishment in Jewish law, in other ancient laws, like in the Code of Hammurabi, limb amputation was the designated punishment for one who commits several offenses, such as a son who strikes his father.

While the Bible makes slight references to the subject, the Talmud, a core Jewish text written in 5th century C.E., indeed directly discusses amputees and prosthetics. It is so ingrained in Talmudic thought, that the Rabbinic authorities in charge of the text assigned unique definitional terms for different types of amputations. According to Rashi in Brachot 58b, a *Kite'a* is an individual whose foot or leg has been cut off and a *Gidem* is someone whose hands or arms have been cut off, most commonly having an amputation at the elbow (Arachin 19b, Orech Chayim 27). Elsewhere in the Talmud, the different types of upper limb amputation, like

amputation of the fingers (Tosefta Bechorot 5:2) and complete amputation of the shoulder (Menachot 37a), are discussed in great detail.

Being that different types of amputation were described throughout the Talmud it follows that prosthetic devices and their relevance to Jewish law be mentioned as well. In Shabbos 65b, there is a discussion about whether one may walk around on Shabbat outside of the restricted boundary with a wooden prosthetic leg. The debate arises from the law in Judaism where one may not carry outside of the *Techum* (restricted area) on *Shabbat*. Rabbi Meir there states that one is allowed to wear their wooden leg outside of the *Techum*, as the prosthetic device is equated to a shoe, and it is known that all clothing may be worn wherever on *Shabbat*. Elsewhere in the Talmud there are even descriptions of prosthetic devices created for animals as well. Rabbi Shimon ben Chalafta, whose chicken somehow dislocated its femur, made a prosthetic support for his animal to regain functionality:

ותרנגולת היתה לו לרבי שמעון בן חלפתא שנשמטה ירך שלה ועשו לה שפופרת של קנה וחיתה

Rabbi Shimon ben Chalafta had a hen whose femur was dislocated, and they made it a support out of the tube of a reed and it lived… (Chullin 57b).

Amputation and Prosthetic Devices in Jewish Law

After describing its presence throughout Jewish history, how do prosthesis and amputation fit within the world of Jewish law? This question centers around the definition of an amputation in *Halacha*; what does one do when they become an amputee? For example, the use of prosthetic arms and legs raises several halachic questions, including whether wearing a pair of phylacteries on a prosthetic arm is permissible, or if one does not have an arm at all. May one use their prosthetic devices on Shabbat? Is a Jew allowed to ritually immerse themselves while wearing a prosthesis? Is a priest with a prosthetic limb fit for service? Although many Halachic sources do not address these questions directly, an analysis of halachic texts on the laws for amputees, along with modern rabbinical responsa, can provide guidance and suggest potential solutions for these halachic inquiries.

Shabbat

The concept of Shabbat within Jewish law is widely-known, even amongst non-Jews. One may not use electricity, drive a car, or go to work, one day a week every week. There are,

however, deeper laws present within the Shabbat observance that tie directly into the use of prosthetic limbs. The main prohibition to focus on is that of carrying on Shabbat outside of a certain designated area from the city known as the *Techum*. It is important to note that clothing, such as a shirt or shoes, would not be considered in violation of this prohibition, and therefore it is vital to understand whether a prosthetic limb can be viewed as being as inseparable to the individual as an article of clothing.

In the Mishnah on Shabbat 66a, there is a discussion of whether or not an amputee using a prosthetic wooden foot may go outside the Techum on shabbos. Rabbi Meir believes that one may use their prosthetic foot on Shabbat, while Rabbi Yossi actually forbids the action. The famed Jewish commentator Rashi explains this argument in greater detail. According to Rashi, Rabbi Meir believes the prosthetic is close enough to a shoe and therefore can be worn outside of the designated boundaries on Shabbat. Rav Yossi, on the other hand, does not believe a prosthetic wooden foot is comparable to a shoe, specifically because wooden shoes were not as popular then, and therefore the devices are too dissimilar. Rabeinu Tam, the grandson of Rashi, has a different interpretation on this disagreement. This is because in Yoma 78b, Rav Yosi and Rav Meir both agree that this wooden prosthetic cannot be worn on Yom Kippur because it is considered a comfy "Shoe", one of the many prohibitions on the Yom Kippur holiday. Therefore, due to their prior agreement, their argument on Shabbat 66a cannot be about whether they believe it's a shoe or not. They both therefore agree it's a shoe and allowed on a biblical level, and the disagreement truly centers around the rabbinic concern of where one is able to easily take off the prosthetic and carry it in his hands. Based on this explanation of the disagreement, the Ramah comments that if the wooden prosthetic has no concern of falling off then its fully legal to wear on Shabbat.

Focusing on an amputee of the upper extremities, it is interesting to note that an individual who has both hands amputated that uses their mouth to write on Shabbat, normally a strict prohibition, would still be in violation of that ruling. This is because, at that point, using their mouth is the normal way in which that amputee writes, thus shifting it into the category of prohibition. Also, according to the renowned Halachic text *Shemiras Shabbos Kehilchasah*, it is fully allowed for an individual with an upper limb prosthetic to walk outside of the *Techum* on Shabbat as it is technically used as his arm and therefore a part of his actual body.

Another issue arises on Shabbat when a person has an electric prosthetic device that operates using a motor. While Rabbis allow for the use of electronic medical devices on Shabbat, such as a glucose monitor for a diabetic, most of the dispensations are reserved for situations that are life-threatening. As a prosthetic limb is necessary for normal functioning, but not considered a life-threatening device, using it on Shabbat may not be permitted. However, if the electronic prosthetic limb cannot be easily removed and is deemed medically necessary to wear throughout the year, a Rabbi may be able to provide a dispensation or find a halachic solution that allows its use on Shabbat.

Phylacteries (Tefillin)

A Biblical law in the Torah is the requirement for a Jewish man above the age of thirteen to don phylacteries every single day for his whole life. The Tefillin are supposed to be wrapped on the weaker arm of the wearer, from the bicep up to the hand. In the case of an amputation of the upper extremities, the rules regarding phylacteries get increasingly more complicated, with many differing opinions regarding how an amputee should approach this topic of Jewish law.

Since most individuals are right-dominated, their left arm is the weaker arm, and that is where they should tie their phylacteries. Therefore the question arises when someone's left hand has been amputated, but the rest of their arm remains intact. The Tosafot say to put the phylacteries on the remaining part of the left arm and make a brachah, while the Ramah says to put it on the left arm without the accompanying brachah, as when there is doubt regarding whether or not to make a Rabbinic brachah in a certain case, then one should err on the side of leniency and avoid saying God's name in vain. Others, like the Magen Avraham, advise to put the phylacteries on the right arm without a brachah, while the Malbim and Ohr Zaruah rule that one is completely exempt from putting tefillin on any arm.

Other relevant cases of amputation include when one's entire left arm is amputated. The Ramah here agrees with the Malbim and Ohr Zaruah and says that one is completely exempt from wearing phylacteries, while the Shevuat Yaakov holds a little more stringently by ruling to put it on the right arm and make both the brachas, for the arm and the head phylacteries, on the head phylacteries exclusively. When one's right hand is amputated, therefore making it impossible to tie his phylacteries alone, The Besamim Rosh holds that one is not obligated because it is not allowed for someone else to tie your phylacteries for you, while the Mishnah

Berurah allows this form of wearing phylacteries. The most important point throughout all of these cases is that, no matter what, if someone cannot put the tefillin on his arm, he must always wear the separate component of phylacteries that goes on one's head [18].

Would the same rulings that apply to an amputee be applicable to someone with a prosthetic arm? Since the Rabbis do not directly address this question, one could speculate through an analysis of the answers given for amputees. If a person's entire arm is amputated up to the shoulder, they would be unable to wear arm phylacteries on their left side, as their prosthetic arm would not be considered a halachic arm. However, if only the forearm is amputated and the biceps are intact with a prosthetic forearm, they could wear phylacteries on their left biceps and wrap them around their prosthetic lower arm with or without a blessing. Additionally, if someone's entire left arm is intact and they only have a prosthetic hand, they would face no issue in wrapping tefillin around their left arm and reciting a blessing.

Priest (Kohen)

In Leviticus 21:17, the Torah writes: "G-d spoke to Moshe, saying: Speak to Aharon, saying: Any man of your offspring throughout their generations in whom there shall be a blemish shall not come near to offer the food of his G-d. For any man in whom there is a blemish shall not approach…" This verse clearly establishes the requirement for Kohanim to maintain a heightened level of purity and flawlessness in order to carry out the sacred sacrificial duties. The Torah addresses various physical impairments that render a kohen ineligible for performing these duties, regardless of whether they were present at birth or acquired later in life. In his work, Maimonides (Chapter 8, Law 1, Laws of the Sanctuary) enumerates a total of ninety different disqualifying blemishes, some of which include a paraplegic kohen or a kohen who has experienced limb loss or amputation.

This disqualification, more relevant for back in the times of the temple, still exists today. The main two types of amputations that would be considered relevant to this ruling are hand amputations and leg amputations. Starting with lower-limb amputations, if a Kohen would be unable to stand properly by the Ark in order to recite the blessing to the congregation, one of the main requirements for a Kohen nowadays, then there would be a prominent issue. Another issue is whether the congregation will be distracted during the priestly blessing due to a lack of limb or prosthetic replacement. In terms of upper-limb prosthetics, a main issue would be that Kohanim

need to use their hands during the blessing, raising them towards the congregation. Again, a missing limb or a prosthetic limb can serve as a distraction and cause a problem for him to recite a blessing. So, even though a Cohen covers his arms (and hands) with his prayer shawl during the Priestly blessing it is still, according to some opinions, problematic for him to recite the blessing [18].

Blemish (*Mum*)

After exploring the ramifications of prosthetic devices within *Halacha*, and specifically in regards to *Kohanim*, the question remains: can a prosthetic device ever remove the title of a *Mum* within an individual in regards to *Halachic* issues? In order to understand the depth of this question, it is necessary to provide a proper definition of a *Mum* within *Halacha*.

A blemish in Halacha is simply defined as a defect in the body of a human or an animal [19]. The requirement for both priests and sacrificial animals is a notion present throughout many cultures. According to records from ancient Egypt, individuals aspiring to become priests underwent scrutiny for any imperfections, just like the animals chosen for sacrifices, which were also thoroughly inspected for suitability. Similarly, Mesopotamian texts indicate that both priests and sacrificial animals had to be flawless, devoid of any blemishes. The Hittites held the belief that the participation of blemished individuals in ceremonial rituals was disrespectful to the gods. The expectation of unblemished priests and sacrifices is also well-documented in the practices of ancient Greece and Rome [20].

There are many different types of blemishes that disqualify both animals and Kohanim from the service. The Rambam himself defines around 50 blemishes that lead to disqualification. Priests serving in the Temple face similar disqualifications as animals when it comes to blemishes. However, in chapter 7 of Bekhorot, there is an additional comprehensive list of blemishes that disqualify priests but are not considered blemishes in animals. These include traits like baldness, a flat nose, bowleggedness, black skin, red skin, albinism, and numerous others. Maimonides specifically identifies 90 blemishes that particularly apply to humans in chapter 8 of Bekhorot [21].

In order to understand why these imperfections lead to the disqualification of certain Kohanim from the Priestly services it is vital to understand the reason why a blemish would cause disqualification in the first place. In the beginning times of the Temple, a blemish

disqualified a *Kohen* simply because of the imperfection it represented and nothing more. It says explicitly in the verse that any *Kohen* with a blemish cannot perform their service. Nowadays, when the priestly service has shifted to just blessings to the congregation during prayers, the reasoning for disqualification has shifted slightly as well:

מַתְנִי׳ כֹּהֵן שֶׁיֵּשׁ בְּיָדָיו מוּמִין לֹא יִשָּׂא אֶת כַּפָּיו רַבִּי יְהוּדָה אוֹמֵר אַף מִי שֶׁהָיוּ יָדָיו צְבוּעוֹת סָטִיס לֹא יִשָּׂא אֶת כַּפָּיו מִפְּנֵי שֶׁהָעָם מִסְתַּכְּלִין בּוֹ:

A kohen who has mumim on his hands may not lift his hands [to recite birkhat kohanim]. Rabbi Yehudah says even one whose hands are colored with satis (a blue dye), may not lift his hands [to recite birkhat kohanim] because the people will look at him (Megillah 24b).

Based on this Mishnah it seems as though the reason for disqualification for a *Mum*, especially in light of a comparison to colored hands, is based on the effect it would have on the congregation rather than it being just a simple pre-determined impurity. Nowadays, the *Kohen* cannot perform his required service of raising his hands during the priestly blessing if it will have a distracting effect on the rest of the congregation. The other Beraisas that discuss this issue as well only mention Mumim located on the hands, feet, or face, which are the visible parts of the body, further proving this theory that distraction for the congregation can be the central issue with today's *Kohanim*. This theory is seemingly confirmed by a Gemara on that very same Mishnah quoted above:

אמר רבי יוחנן: סומא באחת מעיניו לא ישא את כפיו. והא ההוא דהוה בשיבבותיה דרבי יוחנן דהוה פריס ידיה. ההוא דש בעירו הוה.

Rabbi Yoḥanan said: One who is blind in one eye may not lift his hands to recite the Priestly Benediction because people will gaze at him. The Gemara asks: Wasn't there a certain priest who was blind in one eye in the neighborhood of Rabbi Yoḥanan, and he would lift his hands and recite the Priestly Benediction? The Gemara answers: That priest was a familiar figure in his town, and therefore he would not attract attention during the Priestly Benediction (Megillah 24b).

The Gemara on that same page retells a story of a Kohen who was blind in one eye. This imperfection should have seemingly disqualified him from performing his priestly service during prayers. However, the Gemara informs us that since the priest was a staple of his community and people knew of his blemish, they therefore would not be distracted during the priestly blessing in service, and he was allowed to perform his duties. Now, there is *Halachic* precedent for a *Kohen* with a *Mum*, and even an obvious *Mum* to have permission to perform his priestly services. The question remains: are there prosthetic devices that can solve this issue of distraction, and even if not, can a certain level of familiarity for a *Kohen* allow him to perform in the services?

Balance Between Innovation and Halacha

In order to answer whether or not an amputated Kohen can perform his service in today's world, one must look at modern prosthetic devices and their current capabilities. Now, a summary of today's prosthetic devices was provided in an earlier section, and we must revisit that here. The three main types of modern prosthetic devices are passive prosthesis, conventional/body-powered prosthesis, and electrically-powered prosthesis. Passive prosthesis prioritizes the appearance of the prosthetic device over the functionality, and is often used as a "place-holder" solution for individuals waiting on a more functional prosthetic. The other two types of prosthetic devices prioritize that functionality and allow the amputee to regain most of their abilities and lead to the most uninhibited level of living.

First, discussing passive prosthetic devices, the above theory that could allow *Kohanim* to perform their priestly services works beautifully with the passive prosthesis. A prioritization of aesthetics is no problem when figuring out a path to lower the level of audience distraction. If one can develop a modern prosthetic device, whether through 3-D printing or some other format, that truly looks like a proper hand, eye, or foot, regardless of functionality, then perhaps the amputee would not serve as a distraction for the congregation during services. Now, the question remains in this case whether a passive prosthetic device would physically inhibit the wearer from either standing on the *Bimah* or holding up their *Tallit* to even perform the service in the first place, but, on paper, a prosthetic device that looks genuine should allow the *Kohen* to perform his service during prayers.

For the other two types of modern prosthesis it truly depends on the look and design of the prosthetic device. With current 3-D printing and brain-computer interface technology, the

creation of a prosthetic device that looks normal and functions normally is within the realm of possibility [22]. A *Kohen* may be able to create a prosthetic hand or foot that allows him to hold his *Tallit* and stand normally on the *Bimah* without a member of the congregation blinking an eye. Obviously, previous knowledge of a *Kohen's* prosthetic device may serve as a complication, as it could automatically be a distraction regardless of its appearance, however recall the case of the Gemara in Megillah that rules that due to the *Kohen's* familiarity within the community, his blindness no longer served as a distraction. Maybe all *Kohanim* nowadays suffering from limb loss can hope to find both a prosthetic device and a community that makes him feel welcome, comfortable, and uninhibited for the rest of his life.

Conclusion

Since ancient times, dating back to the Pharaohs of Ancient Egypt, prosthetic devices have been utilized to compensate for the loss of limbs. However, the primitive and rudimentary prosthetics of centuries ago bear little resemblance to the advanced devices available today. The advent of modern technology has brought about a revolution in the design and functionality of prosthetic devices, incorporating cutting-edge technological advancements. Furthermore, manufacturing processes have been transformed, shifting from predominantly manual production to automated methods utilizing electronics and computer systems. Despite the remarkable breakthroughs and progress achieved in the field of prosthetics, there is still ample room for further research and innovation to enhance both the mechanism and production of these devices, ultimately improving the lives of individuals who have experienced limb loss.

The utilization of prosthetic devices in replacing lost limbs has enabled individuals to regain a sense of normalcy and diminish the perception of deformity. However, within the realm of Jewish religious law, the status of prosthetic devices is not definitively clear. While certain matters have reached a consensus regarding the observance of Jewish law in relation to individuals with prostheses, other issues such as the wearing of Phylacteries and the ability of a Cohen to bless the public exhibit varying Rabbinic opinions. Moreover, as prosthetic technology continues to advance, incorporating complex integration with a person's musculature, the parameters surrounding religious laws must be reevaluated to determine appropriate halachic conclusions.

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