Original Article

https://doi.org/10.1590/2317-6431-2018-2025

Audiology Communication Research
ISSN 2317-6431

Replacement of hearing aids in hearing health program

Reposição de próteses auditivas em programa de saúde auditiva

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ABSTRACT

Purpose: To verify the causes and the average time of hearing aids replacement of patients of a high complexity system in hearing health in a hospital in the south of Brazil. **Methods**: Electronic charts of patients (children, adults and elders), who received hearing aids through the hearing health program from 2010 to 2017, were analyzed. It was verified the causes, the number, and the average time of replacement, in each of patients' ears. Data were analyzed quantitatively using Pearson's chi-square test or Fisher's exact test, with a significance level at 0.05. **Results:** 1.256 charts of children, adults and elders were analyzed. The main cause of replacement was due to technical failure. In children the average time of replacement was shorter than in adults and the elders. Adults and elders were the groups that needed more replacements. Children's group was the group that needed more than one replacement. **Conclusion:** Technical failure was the main reason why users seek the service to perform a replacement of their devices, and the average time between adaptation and the first replacement was of approximately four years.

Keywords: Audiology; Hearing; Hearing aids; Hearing loss; Health services

RESUMO

Objetivo: Verificar os motivos e o tempo médio de reposição de próteses auditivas em usuários atendidos no sistema de alta complexidade em saúde auditiva, em um hospital no Sul do Brasil. **Método:** Realizou-se consulta aos prontuários dos pacientes (crianças, adultos e idosos) que receberam próteses auditivas por meio do programa de saúde auditiva, no período de janeiro de 2010 a julho de 2017. Foi verificado o motivo da reposição, o número de reposições e o tempo de reposição para cada uma das orelhas. Os dados foram analisados de forma quantitativa, utilizando-se os testes qui-quadrado de Pearson ou exato de Fisher, com nível de significância de 0,05. **Resultados:** Foram analisados 1.256 prontuários de crianças, adultos e idosos. O principal motivo de reposição foi por falha técnica. Nas crianças, o tempo médio da primeira reposição foi menor do que nos adultos e nos idosos. Adultos e idosos formaram o grupo que mais buscou o serviço para realização da primeira reposição de seus dispositivos. As crianças formaram o grupo que mais precisou da segunda e da terceira reposições. **Conclusão:** Trezentos e quarenta e dois pacientes necessitaram repor, no mínimo uma vez, seus dispositivos, tendo como principal motivo a falha técnica. O tempo médio entre a adaptação e a primeira reposição foi de aproximadamente quatro anos.

Palavras-chave: Audição; Audiologia; Auxiliares de audição; Perda auditiva; Serviços de saúde

Study carried out at Curso de Graduação em Fonoaudiologia, Universidade Federal do Rio Grande do Sul – UFRGS e no Hospital de Clínicas de Porto Alegre – HCPA - Porto Alegre (RS), Brasil.

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Conflict of interests: No.
Author's contributions: NLR participated in the designing, analysis and data collection and in the writing process of this article; ASB participated in data analysis and in the writing process of this article; ART participated in the designing, analysis and data collection and in the writing process of this article.
Funding: None.
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Received: May 15, 2018. **Accepted:** January 21, 2019

INTRODUCTION

Hearing impairment (HI) is one of the most common sensory problems in the world population. In general, regardless of age, it has negative consequences on communication, emotional state and quality of life [1,2].

In children and adolescents, HI may affect speech and language development, possibly interfering in the socialization process and schooling if early diagnosis and intervention do not occur. In addition, the central auditory pathways may be affected if there is no adequate stimulation during this period of life [2-4].

Adults and elderly people also suffer from the consequences of hearing loss: isolation, depression and social constraints may be determining factors for the onset or worsening of diseases. Many elderly people feel unable to play their role in society [2,5].

Nowadays, there are resources to help people with disabilities improve their quality of life, including people with hearing impairment. It is possible due to many advances and improvement in medical and technological areas[6]. Sound amplification systems have been developed and continuously upgraded, aiming to reduce the limiting effects caused by HI. Technological tools, such as, hearing aids, may mitigate the impact of hearing loss and increase functional quality of its users[7].

A hearing aid is one of the most important tools when it comes to auditory rehabilitation. Its main functions are; capturing sounds from the environment, amplifying, modifying and transferring them into the user's ear[1,8]. The use of a hearing aid has many benefits, however, in Brazil, its high cost is a factor that enables its acquisition by a high number of individuals. In 2004, the Ministério da Saúde (Ministry of Health) established the Política Nacional de Atenção à Saúde Auditiva - PNASA (National Policy on Hearing Health Care – PNASA) (Ministerial Ordinance MH No. 2,073, of 2004) to improve the hearing health actions of the Sistema Único de Saúde- SUS (Unified Health System), and suggested the organization of an integrated network that would compromise diagnosis and auditory rehabilitation of adults and children[8,9]. In 2005, Ministerial Ordinance No. 387 established the policy for granting hearing aids to SUS patients, through the Serviços de Atenção à Saúde Auditiva (Hearing Health Care Services)[10]. In addition to that, the ordinance, considering that the devices are electronic systems thus subject to failures and malfunctioning, ensures replacement in specific cases, without establishing a minimum term for the replacement. The legislation allows replacement of the hearing aid if the patient proves that he/she had it stolen/robbed or lost it; in case of technical failure of the internal and / or external components, after the warranty period of the device has expired; in the case of progressive hearing loss, based on results of examinations attached to the patient's chart [10].

As hearing aids provided by accredited hearing health programs are funded by public funds, and that replacements overburden not only the human resources of health centers, due to a high demand of professional care, but also on public coffers.

The justification of this study relies on the necessity of knowing the main causes of the replacements, aiming at future plans that allow the reduction of the replacements and, consequently, the expenses resulting from them.

The objective of this study is to verify the causes and the average time of personal hearing amplification devices replacement of patients assisted by a high complexity system in hearing health in a hospital in the south of Brazil.

METHODS

This is a cross-sectional, descriptive and retrospective study, approved by the Comitê de Ética em Pesquisa do Hospital de Clínicas de Porto Alegre -CEP- HCPA (Research Ethics Committee of the Hospital de Clínicas of Porto Alegre) Universidade Federal do Rio Grande do Sul – CEP-UFRGS (Federal University of Rio Grande do Sul), under the number 2.056.184. As a retrospective study, with consultation on patients' electronic charts, the researchers signed, replacing the Termo de Consentimento Livre e Esclarecido (TCLE) (Informed Consent Form), the Termo de Utilização e Confidencialidade de Dados (TCUD) (Confidentiality of Data Agreement Form). The form is a standard document of the origin institute to maintain the secrecy and confidentiality of the medical charts and the collected data.

The electronic medical charts of patients fitted with hearing aids at the hospital were analyzed from January 2010 to July 2017. Various aspects were verified: date of the first adaptation, whether it was unilateral or bilateral, and the device used, according to the ordinance of the national policy on health care hearing (A, B or C). After that, we analyzed the causes of replacement, the date of replacement, and whether it was a unilateral or a bilateral replacement. Criteria, such as; gender of the patient, his/her age on adaptation and replacement were included in this study. The charts which data was not complete on the system and those without cause of replacement were excluded from this study. To categorize the hearing aids, we based our study on the classification listed on Ordinance 835 of 2012, regarding technology, and Ordinance 589 of 2014, regarding replacement. Being type A the least technological one, and type C the most technological one, with a lot of resources.

Sample size calculation was performed on the WinPEPI *(Programs for Epidemiologists for Windows)*, version 11.43. To a significance level of 5%, margin of error of 5%, estimating the number of appointments for verification/ replacement of hearing aids performed annually by the local, considering a period of approximately ten years, a total minimum of 318 patients was designed.

After data collection, the analysis was conducted using the software Statistical Package for Social Science for Windows (SPSS), version 21.0. Quantitative variables were described by average and standard deviation, or median and interquartile range. Categorical variables were described by absolute and relative frequencies. For the analyzes by age group, subjects between 0 and 12 years old were considered children, subjects between 12 and 18 years old were considered adolescents [11], subjects between 19 and 59 were considered adults and individuals aged 60[12] or over were considered elders.

To evaluate the association between the variables, Pearson's chi-square test or Fisher's exact test were used. The significance level used was at 5% ($p \leq 0.05$).

RESULTS

A total of 1.311 charts of patients fitted with hearing aids were analyzed from January 2010 to July 2017, 55 charts were excluded due to incomplete data. Therefore, data concerning the rehabilitation of 1.256 patients were included in this study, of whom 342 needed to have their devices replaced at least once.

There was no significant association between gender and variables related to the replacements ($p>0.10$). The average age of the first adaptation was 44.1±27.1 years (Table 1).

Regarding the replacements, it was noticed that, of the total sample, 342 (27.2%) patients needed a first replacement. The average time between adaptation and the first replacement was 43.1±15.9 months. Considering the age group, elders and adults showed a longer period of time, from the initial adaptation until the replacement, than children (p=0.001). Once again, technology C was the most used one among subjects who needed to have their devices replaced. Technical failure was the main cause of replacement in all age groups. In the adult group, it was observed a higher number of replacements due to technical failure of hearing aids used in the left ear (p=0.03) (Table 2).

Table 1. Description of the sample

Variables	n=342
Gender- n(%)	
Female	170 (49.7)
Male	172 (50.3)
Age in the 1st adaptation (years) – average ± SD	44.1 ± 27.1
Average age in the 1st adaptation – n(%)	
Children (≤11)	73 (21.3)
Adolescents (12-18)	32 (9.4)
Adults (19-59)	109 (31.9)
Elders (≥60)	128 (37.4)
Hearing aid technology 1st adaptation Right ear – n(%)	
Without adaptation	3 (0.9)
A	32 (9.4)
B	102 (29.8)
C	205 (59.9)
Hearing aid technology 1st adaptation Left ear – n(%)	
Without adaptation	3 (0.9)
A	30 (8.8)
B	105 (30.7)
C	204 (59.6)

Caption: SD = standard deviation; % = percentage; n = absolute value; A = hearing aid technology type A; B = technology type B; C = technology type C

Table 2. Data about the first replacement

Variable	Total sample	Children	Adolescents	Adults	Elders	Value of p
	(n=342)	(n=73)	(n=32)	(n=109)	(n=128)	<0,0001
Time between adaptation and replacement (months) – average ± SD	43.1 ± 15.9	36.7 ± 15.4a	42.8 ± 14.1ab	44.8 ± 17.1b	45.3 ± 14.7b	0.001
Hearing aid technology 1st replacement Right Ear – n(%)						0.51
Without replacement	24 (7.0)	7 (9.6)	2 (6.3)	7 (6.4)	8 (6.3)	
A	27 (7.9)	6 (8.2)	2 (6.3)	12 (11.0)	7 (5.5)	
B	80 (23.4)	23 (31.5)	8 (25.0)	21 (19.3)	28 (21.9)	
C	211 (61.7)	37 (50.7)	20 (62.5)	69 (63.3)	85 (66.4)	
Hearing aid technology 1st replacement Left Ear – n(%)						0.933
Without replacement	26 (7.6)	8 (11.0)	3 (9.4)	7 (6.4)	8 (6.3)	
A	29 (8.5)	7 (9.6)	2 (6.3)	11 (10.1)	9 (7.0)	
B	75 (21.9)	17 (23.3)	8 (25.0)	23 (21.1)	27 (21.1)	
C	212 (62.0)	41 (56.2)	19 (59.4)	68 (62.4)	84 (65.6)	
Ear of the replacement – n(%)						0.92
Right	27 (7.9)	7 (9.6)	3 (9.4)	8 (7.3)	9 (7.0)	
Left	23 (6.7)	7 (9.6)	2 (6,3)	7 (6.4)	7 (5.5)	
Both ears	292 (85.4)	59 (80.8)	27 (84.4)	94 (86.2)	112 (87.5)	
Causes of replacement RE – n(%)						0.125
Technical failure	244 (76.3)	44 (67.7)	25 (83.3)	88 (84.6)	87 (71.9)	
Loss	33 (10.3)	9 (13.8)	3 (10.0)	5 (4.8)	16 (13.2)	
Theft	43 (13.4)	12 (18.5)	2 (6.7)	11 (10.6)	18 (14.9)	
Causes of replacement LE – n(%)						0.03
Technical failure	249 (78.1)	46 (67.6)	24 (82,8)	91 (89.2)*	88 (73.3)	
Loss	31 (9.7)	10 (14,7)	2 (6.9)	4 (3,9)	15 (12,5)	
Theft	39 (12,2)	12 (17,6)	3 (10,3)	7 (6.9)	17 (14,2)	

a,b Same letters do not differ – Turkey test at 5% of significance; * significant association – test of residues adjusted to 5% of significance.

Caption: RE = Right ear; LE =Left ear; n = absolute value; % = percentage; SD = standard deviation; A = hearing aid technology typo A; B = technology typo B; C = technology type C

The second replacement was necessary for 43 (12.6%) subjects, and the average time from initial adaptation until the second replacement was 55.7 ± 13.8 months. There was a difference between the age groups. Children and elders showed a similar period of time from the initial adaptation until the second replacement, shorter than the period presented in other age groups (Table 3).

Six patients needed a third hearing aid replacement, predominantly children. The average time from initial adaptation until the third replacement was 61.1±13.9 months. The elders had the shortest period of time of replacement from initial adaptation until the third replacement (Table 4).

Regarding the percentage of patients who needed second and third replacements, the prevalence of children stands out, with a significant association in both replacements (Figure 1).

Table 3. Data about the second replacement

Variables	Total sample (n=342)	Children (n=73)	Adolescents (n=32)	Adults (n=109)	Elders (n=128)	Value for p
Second replacement – n	43	17 *	3	16	7	0.003
Time between adaptation and second replacement (months) – average ± SD	55.7 ± 13.8	51.6 ± 14.1	64.7 ± 9.2	60.7 ± 10.9	50.6 ± 17.0	0.116
Hearing aid technology 2nd replacement						0.126
Right Ear – n(%)						
A	2 (4.3)	1 (5.6)	0	0	1(12.5)	
B	13 (29.8)	9 (50)	0	3 (22.2)	1(12.5)	
C	28 (66.0)	7 (44)	3 (100)	13 (77.8)	5 (75)	
Left Ear – n(%)						0.211
A	1 (2.4)	0	0	0	1(12.5)	
B	10 (28.6)	7(46.7)	0	2(22.2)	1 (12.5)	
C	28 (69.0)	8 (53.3)	1(100)	14 (77.8)	5 (75.0)	
Ear of replacement – n(%)						0.188
Right	8 (18.6)	4 (23.5)	2 (66.7)	1 (6.3)	1 (14.3)	
Left	2 (4.7)	0 (0.0)	0 (0.0)	1 (6.3)	1 (14.3)	
Both ears	33 (76.7)	13 (76.5)	1 (33.3)	14 (87.5)	5 (71.4)	
Causes of replacement RE – n(%)						0.686
Technical failure	32 (78.0)	12 (70.6)	3 (100)	13 (86,7)	4 (66.7)	
Loss	2 (4.9)	1 (5.9)	0 (0.0)	1 (6.7)	0 (0.0)	
Theft	7 (17.1)	4 (23.5)	0 (0.0)	1 (6.7)	2 (33.3)	
Causes of replacement LE – n(%)						0.649
Technical failure	28 (80.0)	9 (69.2)	1 (100)	13 (86.7)	5 (83.3)	
Loss	1 (2.9)	0 (0.0)	0 (0.0)	1 (6.7)	0 (0.0)	
Theft	6 (17.1)	4 (30.8)	0 (0.0)	1 (6.7)	1 (16.7)	

* statistically significant association (p<0,005) - Test of residuals adjusted to 5% of significance
Caption: n = absolute value; % = percentage; SD = standard deviation; RE = right ear; LE = left ear

Table 4. Data about the third replacement

Variables	Total sample (n=342)	Children (n=73)	Adolescents (n=32)	Adults (n=109)	Elders (n=128)	Value of p
Third replacement – n	7	5 *	0	1	1	0.013
Time between adaptation and third replacement (months) – average ± SD	61.1 ± 13.9	65.0 ± 12.1	-	64.0 ± 0.0	59.0 ± 0.0	0.257
Hearing aid technology 3rd replacement						
Right Ear- n(%)						<0.0001
A	-	-	-	-	-	
B	2 (28.57)	2 (100)	-	-	-	
C	5 (71.43)	3 (75.0)	-	1 (12.5)	1 (12.5)	
Left Ear- n(%)						<0.0001
A	-	-	-	-	-	
B	2 (28.57)	2 (100)	-	-	-	
C	5 (71.43)	3 (75.0)	-	1 (12.5)	1 (12.5)	
Causes of replacement RE- n (%)						<0.0001
Technical failure	7(100)	5 (100)	-	1 (100)	1(100)	
Theft	-	-	-	-	-	
Loss	-	-	-	-	-	
Causes of Replacement LE- n (%)						<0.0001
Technical failure	7(100)	5 (100)	-	1 (100)	1(100)	
Theft	-	-	-	-	-	
Loss	-	-	-	-	-	

* statistically significant association (p<0,005) – Test of residuals adjusted to 5% of significance
Caption: n = absolute value; % = percentage; SD = standard deviation; RE = right ear; LE = left ear

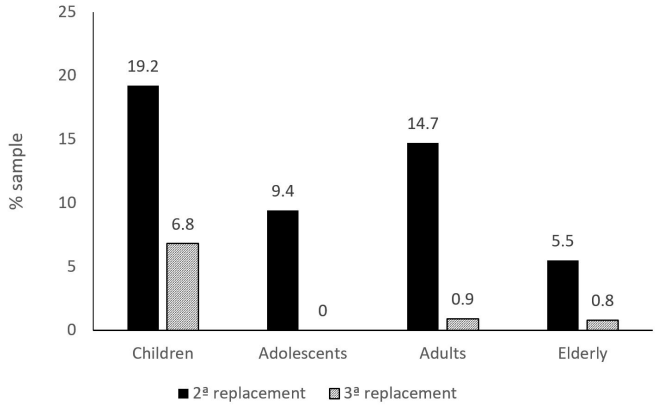

Figure 1. Replacement according to age group significant association - test of residuals adjusted to 5% of significance
Subtitle: % = percentage

DISCUSSION

The data collected in this study shows that, considering the sample analyzed, a high number of adults and elders patients received hearing aids for the first time. It may be justified considering the profile of the patients assisted at the place, where there are more referrals for the two mentioned groups. It also shows that, the increasing of the number of individuals who suffer from hearing loss is directly related to the ageing of the population. Presbycusis is one of the diseases related to ageing that causes loss of communicative and effective abilities. It may cause isolation, deprivation of sources of information and negative emotional impact on peoples' lives, which become a limiting factor for the subject [13-16]. Scientific evidence on auditory rehabilitation and reintegration of the elderly people in society are described in the specialized literature [13].

The high number of adults and elders fitted with hearing aids can explain why, in the first adaptation of hearing aids, technology devices type C, which are more advanced, were preferred over technology devices types A and B. The average age of 44.1± 27.1 years, in initial adaptation, shows that most of the patients were active, both in the job market and in social life; consequently, devices with more resources were required.

About the first replacement, adults and elders are the groups that seek the service the most. It is possible that, from all individuals who seek this type of health services in the country, the predominant part has low level of schooling [17,18]. This would explain some difficulties that patients may have to handle their devices, resulting in technical failures. Elderly patients may find it more difficult to understand how to handle their devices, which may compromise the correct use and shorten the lifespan of their devices. The fact that many of them cannot attend the appointments accompanied by a family member or a caregiver, someone who could instruct them later, maybe is another important factor for the shortening of the lifespan of patient's devices.

The proper handling and maintenance of hearing aids are very important to a successful use. New users, in general, on the day they receive the device, are given much information in a short period of time. Such procedure may be a difficult moment for elders, who may have cognitive and memory deficits. As a result, they may not retain all the necessary information to properly wear the hearing aid and perform maintenance tasks, which are essential for a proper functioning of the device [19]. Moreover, those users tend to have high expectations and be eager to adjust their hearing aids, detracting attention from the instructions about the use of the devices. It reflects directly on the care needed to keep the devices working properly.

As for the replacement time of the devices, there is no concise information, in the literature, about the average durability of the amplification devices. However, it was found that the average time between adaptation and the first replacement can be considered short. Manufacturers, according to the Código Brasileiro de Defesa do Consumidor (Brazilian Consumer Defense Code), must ensure a one-year warranty (365 days) and replacement parts for at least five years. Based on that, it was believed that the first technical failures would occur after that time period (60 months). However, the researchers found out a shorter period of time than assumed.

The main reasons for the replacements were technical failures, in all age groups. The data supports the possibility concerning new users and difficulties that patients may have to handle their devices, which shortens the lifespan of their hearing aids. Based on the literature reviewed [20,21], failures of hearing aids are related to: battery, humidity, molds/capsules problems and cerumen. Some studies have shown that one of the main reasons that cause malfunction of the devices, and even deterioration [22-24], may be related to the difficulty of HA handling.

The high number of replacements due to technical failure of the hearing aids causes disorders for the system, not only in financial terms. Patients whose devices have technical failure, and who need to have their devices replaced, do not need to be re-enrolled in the hearing health system. As most of these patients cannot afford the necessary repairs, a new device is granted, which creates a financial burden for the system and impacts on the number of services performed by professionals.

Regarding the second and third replacements, there was a difference among the groups, being the children's group the one that needed more replacements. It is believed that it happens due to poor handling by those users, who still do not know how to properly handle and take care of their hearing aids. Many children do not know how to perform the necessary tasks to maintain a proper functioning of the device, which causes shortening of its lifespan. Additionally, children participate in activities that may risk the safety of their devices. When playing games, children may expose, unintentionally, their devices to falls, impacts, humidity, among other problems that can damage the devices. Another argument that may support the findings is that older adults, as they become familiar with their devices, become more careful, thus avoiding further replacements of devices.

A possible solution to reduce the number of patients who need replacement of their hearing aids is to increase the number of appointments, in order to clarify all doubts about the handling of the devices. With more appointments, patients would have a chance to solve their doubts about handling and maintenance, increasing the life of the device. Nevertheless, it would increase working hours or the number of professionals required in hearing care services. It is important to mention that, at the place, where the study was conducted, the adaptation protocol includes an appointment to give the patient the device and the initial adaptation of the hearing aid (basic instructions related to handling and maintenance). After that, the patient has

a follow-up visit with a phonoaudiologist, the same professional who gave the patient a hearing aid in the first appointment, to perform the necessary adjustments and give new instructions (it usually happens 15 to 30 days after the patient receives his/her hearing aid). It is possible to schedule additional follow-up visits to adjustment and instructions, if necessary. Due to long distance from some patients' locations and the place where the adaptation is performed, the number of follow-up visits is not enough.

Another important factor in hearing health services is the investment in guidelines for patients. Audio visual support materials, such as brochures and explanatory videos, as a means to improve knowledge about the handling and maintenance of the devices. The support material would have to be designed considering the specific group age, schooling and cognition levels of the patient. Since, nowadays, instructions on hearing aids manuals are hardly ever read or understood by most patients and family members.

Changes in Ordinances (835 of 2012 and 589 of 2014) are also an attempting to lower public expenses with replacements; for instance, to invest in hearing aids repairing would lead to cost reduction.

Since the instructions about the handling of the devices are as important as the adaptation itself, the phonoaudiologist plays a relevant role in this context. Investments on changes in hearing health services are a possible way to reduce the high cost of replacements. Giving patients instructions about the handling and maintenance of hearing aids is crucial. Once the procedures are understood, patients with hearing loss are able to use their devices in a more effective and careful way. Consequently, they will know that public resources were used for the acquisition, and will take responsibility in the use, maintenance and handling of their devices.

As this study was retrospective, electronic medical charts of patients from the hospital were analyzed, it is important to highlight that the study has its limitations. One of them concerns the effective use of the provided hearing aids.

Considering that, during the period of this study, many of the patients were using devices that did not have technology (*datalogging*) to track the time of use, because of this, daily time of use was not possible to be verified. Another limitation has to do with the lack of specific information about the technical failures of the devices. The patients only had the cost estimated by a licensed company. However, there was no information on the medical chart about what was causing the improperly functioning of the device.

CONCLUSION

It was found that, during the period of seven years, 342 (27.2%) out of 1.256 patients fitted with hearing aids needed at least one replacement. The main reason for the replacements was related to technical failure, followed by loss/ theft and progressive loss of hearing. The average time between adaptation and the first replacement was 43,1±15,9 months; 86 users (6.55% of the total) needed a second replacement of their hearing aids, which occurred 55,7±13,8 months after the first adaptation; the third replacement occurred 61.1±13.9 months after the adaptation, being performed in 2% of the total of patients.

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