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Original article on: What are the functional results of prostheses after lower limb amputation?

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Abstract

Introduction: Very little is known about amputations in our setting. What are the functional results of amputated lower limb replacement prostheses in our context?

Methodology: To answer this question, we carried out a preliminary descriptive cross-sectional survey from February to April 2020 of all lower limb amputees whose prosthesis were done at the National Center for the Rehabilitation of People with Disabilities (NCPD) between 2015 and 2019. Patients were amputated in or out of the NCPD, and came for prosthesis. We used the Questionnaire for Trans Femoral Amputations (Q-TFA) of Kerstin Harberg modified and adapted to transtibial amputations where needed.

Results: We had 53 patients. The mean age was 46.92 [19-75] years old. The sex ratio was 3/1 with 41 men and 12 women. The upper 1/3 of the leg was the most common amputation level at 33.96%. The left side was the most amputated side, 54.72%. The main cause of lower limb amputation was trauma with 52.83%. The stump scars were invaginated (49.06%), flat (28.30%) or adherent (22, 64%). The stumps were tonic (81.13%), flabby (11.32%) atrophied (7.55%). The most widely used prosthesis was the one with a sleeve made from EVA (Ethylene-Vinyl-Acetate) and the socket from polypropylene (43.40%). The daily wearing of the prosthesis was 37.74%. Phantom limb pain, stump pain, stump fatigue, and inability to walk quickly were the most common difficulties with 43.40%, 41.51%, 37.73% and 35.85% respectively. 76.92% amputees needed a walking aid and 38.46% needed two crutches to move. Without assistance, they could: stand for 10-15 minutes (81.13%), sit comfortably on a low chair (92%), tie laces while sitting and bent forward (86.54%) and easily sit on the ground and get up (86.96%). With the walking aid they could: go up and down stairs without a holding the ramp (77.36%), go up a slope (75.47%), go down a slope (75%), walk on uneven ground (57.69 %) and walk quickly for a distance of 50 meters (37.74%). A daily walking perimeter of 10, 50, 200, 500 and 1000 meters was possible for 96.15%, 84.31%, 50.98% 23.53% and 0% of the patients. After amputation, 56.60% of patients could concerve their previous employment.

Conclusion : These preliminary results are encouraging and can be improved.

Keywords: Prostheses of the amputated lower limb - Functional results

1. Introduction

Amputation consists of the surgical removal of a limb or a segment of a limb [1]. A prosthesis designates an internal or external device that replaces either a limb or part of an amputated limb in order to perform the same function. These are, as far as possible restored in whole or in part, as well as their forms which are adapted to cope perfectly with the body. The purpose of the prosthesis is to restore autonomy to the person, relieve their pain, reintegrate them into their home and into their socio-professional life [2].

Amputation is one of the oldest surgeries performed for a variety of indications [3] and the current context is marked by the resurgence of road accidents and vascular pathologies as the main causes of amputation in the countries developing countries such as Cameroon. Its frequency is variable [4]. Approximately 200 to 500 million major amputations are performed worldwide each year [5]. Approximately 1.6 million individuals worldwide are amputated [6].

Imam et al. In 2017, the incidence of lower limb amputations in Canada was 44,430 [7].

The care of a Person with Lower Limb Amputation (PLLA) is of vital socio-economic and professional interest. The optimization of this reintegration depends on the equipment which must be adapted to overcome his new situation of disability [8], taking into account his expectations and functional needs [9]. New materials, electronics, biochips have enabled the development of new prostheses.

To our knowledge, an epidemiological study in 2010 [10] and a hospital patient satisfaction survey in Yaounde were carried out in 2018, on physical, psychological and social satisfaction [11]. There are no other local data on functional results.

What are the functional outcomes of amputated lower limb replacement prostheses in our context regarding frequency and duration of use, level of function, and difficulties encountered with the amputated lower limb replacement prosthesis?

Methodology

We carried out from February 1st to April 30th, 2020, a descriptive cross-sectional survey of "Lower Limb Amputee" (PLLA) and whose prosthesis was done in the National Center for the Rehabilitation of Persons with Disabilities (NCPD) over 5 years, that is from January 1 st, 2015 to December 31 st, 2019. The amputations were made outside and at the NCPD, but all the prostheses were made and followed up at the NCPD: programming, trial prosthesis, adjustments, final prosthesis, later follow-up initially monthly. Our minimum follow-up was 6 months and the maximum 5 years after the prosthesis.

Were included in the study (Figure 1), all Persons with Lower Limb Amputations (PLLA), uni or bilateral, aged at least five years. Excluded from the study were PLLAs who had no medical records and patients who had been fitted for less than 6 months.

Fig 1: Amputees and prosthesis

The sampling method adapted to the study was non-probability. The questionnaire was administered to all patients fulfilling the inclusion criteria and agreeing to participate in the study.

The collection instrument consisted of the so-called Q-TFA questionnaire (Questionnaire for People with Transfemoral

Amputation) by the author KERSTIN HAGBERG [12]. It has been modified and adapted for transtibial amputations where relevant. This questionnaire, made up of thirty-six questions, is subdivided into six main sections from A to E: section A is related to general data, section B to the clinical characteristics of the patients, section C to the characteristics of the prosthesis (types and cost), section D to the use of the prosthesis, section E to the level of function with the prosthesis and section F to the difficulties with the prosthesis and their impact.

Subjects were informed about the purpose and objectives of the study. Informed consent was obtained from each patient before administering the questionnaire. We obtained the autorisation from the National Health Ethics Committee.

The continuation of the filling of the questionnaires was done in 8 to 12 minutes by interviews through different methods in particular:

- Inviting patients to come to the centre;
- Home visits to patients who were in the city of Yaoundé and who were unable to travel to the center and
- Telephone calls for patients who lived in remote villages and for those who did not want home visits.

The data was checked, coded, entered in double entry and analyzed through the Epi info 7.2.2.6 software. Excel 2013 was used for charts and tables.

Results

1. General data

A total of 53 patients were selected. The average age was 46.92 [19-75] years. The sex ratio was 3/1 with 41 men and 12 women. 56.60% (30/53) of respondents were married, 22.64% (12/53) single, 7.55% (4/53) widowed and 13.21% (7/53) divorced.

There were 30.19% (16/53) unemployed, 22.64% (12/53) civil servants, 13.21% (7/53) traders, 9.43% 11.32% (6/53) retirees, 9.43% (5/53) workers, 9.43% (5/53) students and 3.77% (2/53) soldiers.

Transfemoral and transtibial diaphyseal amputations were the most represented: proximal 1/3 of femur 7.55%, middle 1/3 : 24.53% and distal 1/3 :7.55%; Concerning leg amputations : the proximal 1/3 was 33.96%, middle : 15.09% and distal 1/3 : 11.32%. The proximal 1/3 of the leg was the most represented level of amputation, with 33.96% (18/53). The left side was the most amputated side, with 54.72% (29/53).

The main cause of amputation (Table 1) of the lower limb was trauma, which accounted for 52.83% (28/53) of the causes, followed by diabetes and gangrene, with 18.87% (10/53) each, then causes infectious are 5.66% (3/53) and vascular and 3.77% (2/53).

Concerning the scars, 49.06% (26/53) of the amputees had invaginated scars, 28.30% (15/53) had flat scars and 22.64% (12/53) had adherent scars.

The stumps were either tonic with 43/53(81.13%), flaccid with 6/13(11.32%) or atrophic with 4/53(7.55%). The bulbous-shaped stump was the most represented, with 64.15% (34/53) followed by the cylindrical-shaped stump, with 32.08% (17/53). The conical stump was the least represented with 3.77% (2/53).

The most used prosthesis (Table 1) was the one whose sleeve was made of EVA (Ethylene-Vinyl-Acetate) and the socket of Polypropylene (43.40%). The average cost of the prostheses was 744,340 [300,000 – 1,400,00] FCFA. 1000 FCFA been equivalent to 2,20 United States Dollars.

Table 1: General data

A. Causes of amputation			**Frequency**	**Percentage**
Trauma			28	52,83%
Diabetes			10	18,87%
Gangrene			10	18,87%
Vascular			3	5,66%
Infection			2	3,77%
Total			53	100%
B. Amputation levels			**Frequency**	**Percentage**
Thigh proximal 1/3			4	7,55%
Thigh medium 1/3			13	24,53%
Thigh distal 1/3			4	7,55%
Leg proximal 1/3			18	33,96%
Leg medium 1/3			8	15,09%
Leg distal 1/3			6	11,32%
Total			53	100%
C. Types of prostheses			**Frequency**	**Percentage**
	Sleeve	Socket		
Type 1	EVA*	Propylene	23	43,40%
Type 2	EVA*	Resin	12	22,64%
Type 3	Silicone	Propylene	8	15,09%
Type 4	Silicone	Résine	10	18,87%
Total			53	100%
EVA*= Ethylene-Vinyl-Acetate				
D. Prostheses costs				
	Sleeve	Socket	Average costs in FCFA*	
Type 1	EVA*	Propylene	502 620	
Type 2	EVA*	Resine	770 830	
Type 3	Silicone	Propylene	887500	
Type 4	Silicone	Resine	1 065 000	
Mean (ponderated)			744340	

*1000 FCFA is 2,20 United States Dollars

2. Functional results of the use of prostheses

2.1 Use of the prosthesis

a) Frequency of wearing prostheses per week

The number of days of wearing the prosthesis per week is 3 days (15.09%), 4 days (3.77%), 5 days (15.09%), 6 days (28.30%) and 7 days (37.74%).

b) Duration of use of the prosthesis per day

The number of hours of prosthesis wearing per day was 0-3h (15.09%), 4-6h (11.32%), 7-9h (11.32%), and 10-12h (16.98 %). In general, 62.26% (33/53) of PLLA used the prosthesis at least 13 hours per day.

c) Reasons for not wearing the prosthesis

Stump pain (41.51%), skin irritation (43.40%), slow speed (35.85%), having to use the hand assistance for walking (20. 75%), phantom limb pain (18.87%), heaviness (16.98%), pain when wearing a prosthesis (15.09%), painful wearing (11.32%), prosthesis mismatch (11.32%) and prosthetic component failure (9.43%) were the most common reasons for not wearing the prosthesis.

2.2. Level of function with the prosthesis

a) Need for walking assistance

The study showed that 76.92% of PLLAs needed walking assistance and used two crutches (38.46%), one crutch (28.85%) or a walker (7.69%) to move. On the other hand, 23.08% moved around without help.

b) Movements performed with the support of the walking aid

With the walking aid they could: go up and down stairs without a ramp (77.36%), go up a slope (75.47%), go down a slope (75%), walk on irregular ground (57.69 %) and walk quickly over a distance of 50 meters (37.74%).

c) Movements performed without walking aid

Without help, they could: stand for 10-15 minutes (81.13%), sit comfortably on a low chair (92%), tie the shoe laces in a seated position and bending forward (86.54%), easily sit on the floor and get up (86.96%).

d) Walking perimeter

A daily walking distance of 10, 50, 200, 500 and 1000 meters was possible for 96.15%, 84.31%, 50.98% 23.53% and 0% of patients.

2.3. Change of profession after amputation

After the amputation, 56.60% (30/53) of PLLA kept their previous job against 13.21% (7/53) who changed; 30.18% (16/53) of PLLA were unemployed.

2.4. Difficulties and quality of life

Phantom limb pain, stump pain, stump fatigue and the inability to walk quickly were the most frequent difficulties in the PLLA with the device, at 43.40% (23/53), 41.51% (22 /53), 37.73% (20/53) and 35.85% (19/53) for each of these difficulties respectively (Table 2).

Table 2: Distribution according to the difficulties encountered with the prosthesis

	Number of cases	Proportions
Phantom pain	23	43,40%
Stump pain	22	41,51%
Stump fatigue when walking	20	37,73%
Difficulty walking fast	19	35,85%
Friction and injuries	18	33,96%
Appearance of the prosthesis (color, shape and surface)	16	30,19%
Limping	15	28,30%
Difficult sitting position	12	22,64%
Inability to rely on a firmly attached prosthesis	11	20,75%
Hands busy with walking aid	10	18,87%
Disturbed by the noises of the prosthesis	9	16,98%
Heaviness of the prosthesis	9	16,98%
Opposite limb pain	7	13,21%

Discussion

The objective of this study was to determine the functional results in terms of frequency and duration of use, level of function and difficulties encountered with the lower limb replacement prosthesis. The study was of a descriptive cross-sectional type over a period of 5 years, involving 53 PLLA fitted at the NCDP in Yaounde. Our results are discussed in Table 3, in comparison with those of other authors concerning patients, methods and results [13-16].

Table 3: Discussion of our results

Etude	Our study	Houda and al. [13]	Dilingham and al. [14]	Hoffman and al. [15]	Refaat and al. [16]
Year	2019	2019	2001	2002	2002
Country	Cameroon	Tunisia	United States of America		
Study sample size	53 cases	85 cases	78 cases	35 cases	66 cases
Mean age	46 years	59 years	33 years	43 years	52 years
Sex ratio M/F	73%	75%	87%	56%	91%
Cause	Trauma 52%	Diabetes	Trauma 100%	Tumors 100%	Tumors 100%
Trans femoral	40%	70%	20%	100%	51%
Trans tibial	60%	30%	80%	0%	49%
Prorhesis or not	100%	100%	95%	17%	91%
Frequency of prosthesis	6days/7	Better results on	80hours/7j	Not every day	

wearing		quality of life in post-traumatic and young people -			
Number of hours per day	10-12 hours			12 hours	
Reason for not wearing	pains		-	-	-
Aided with 1 crotche	29%		32%	42%	30%
Phantom pain	43%		24%	58%	30%
Job Conservation	25%	-	-	-	-

The main limitation of this study was the information or memory bias, given that the questionnaire included a large number of items. However, the investigator took enough time to explain the questions and to check for inconsistent answers. In addition, some major difficulties were noted, in particular the small sample size.

Concernning patients, our modest sample size is lower than those of Tunisian authors [13] who in 2019 published on 85 cases. Our average age of 46 years is higher than the 33 years of the American studies of Dilingham et al. [14] and the 43 years of Hoffman et al. [15], but remains lower than the 46 years of Houda et al. [13] and the 52 years of Refaat et al. [16]. The sex ratio is in favor of men as in other publications [13-16].

The amputation in our study was often transtibial (60%). This preponderance of the tibial level is contrary to the result of Houda et al. [13] who mainly amped transfemorally (70%) but are in the same direction as Dilingham et al. [14] who had 80%. This could be justified by the fact that vascular amputations are higher than traumatic ones.

The functional results are similar to those of other authors. Regarding assisted walking with 1 cane, for example, we had 29% for our study against 32% for Dilingham et al. [14], 42% for Hoffman et al. [15] and 30% for Refaat et al. [16]. Phantom limb pain was present in 43% of cases in our study versus 24% for Dilingham et al. [14], 58% for Hoffman et al. [15] and 30% for Refaat et al. [16].

Conclusion

The functional results of prosthetic PLLAs are generally satisfactory, the majority using the prosthesis daily for 13 to 15 hours a day, with a walking distance ranging from 10 meters to 500 meters. However, phantom pain, stump pain and fatigue during prosthetic walking, heaviness of the prosthesis and the inability to walk briskly were obstacles to the efficient use of the prostheses.

Thanks

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Conflicts of interest

None.

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