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Breast Reconstruction: economic impact on swiss health insurance system

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Abstract

Introduction: Breast reconstruction, involving highly specialised medical teams, multiple operations and tight follow-up, has a considerable impact on the health system.

Considering present concerns about healthcare costs, and the lack of evidence and published articles on breast reconstruction costs in Switzerland, we retrospectively investigated charges to the Swiss healthcare system for different breast reconstruction procedures at the Centre Hospitalier Universitaire Vaudois. Data have been statistically analysed and discussed.

Method We selected all hospitalized patients in the Reconstructive Surgery unit at the University Hospital of Vaud in Switzerland (CHUV) who underwent a “total” breast reconstruction, meaning from main intervention following total mastectomy to nipple reconstruction and tattoo, from January 2012 to December 2015. Analysis included 76 women who underwent both autologous or implant based reconstructions. Four breast reconstruction techniques were included: Deep Inferior Epigastric Perforator (DIEP) autologous flap reconstruction, Tissue Expander followed by Implant (TE/I), pedicled Latissimus Dorsi (LD) flap with or without tissue expander and implant (LD +/- TE/I).

Costs of the different procedures, as well as the number of required operations, the total operation time, and the duration of the main surgeries were statistically compared.

Results Global costs for DIEP reconstruction were $29'728 \pm 1'892$ CHF (ave \pm Std. Error of Mean), while TE reconstruction showed a significantly higher global cost, reaching an average of $44'313 \pm 5'553$ CHF (ave \pm Std. Error of Mean). LD showed a similar cost, comparing to the DIEP ($29'813 \pm 3637$ CHF), rising when including an implant ($37'688 \pm 4'840$ CHF). Despite a significantly longer operation time, DIEP flap resulted to be significantly cheaper than TE/I. No significant differences in the number of interventions were detected.

Conclusion These data show that, at least according to the swiss insurance system refunds, the intervention with the best cost-benefit ratio is DIEP, considering its lower rate of complications and lower overall costs. Implant-based reconstructions show, a greater likelihood of complications and re-intervention, globally creating superior costs when compared to autologous reconstructions.

Introduction

According to the Swiss Cancer League, more than 15 women develop breast cancer every day in Switzerland. This translates to approximately 5'500 women a year [1] or 110 new cases per 100'000 inhabitants per year [2]. Breast cancer is, and has been for decades now, the deadliest cancer for women [2]. The mortality rate 5 years after diagnosis rises as high as 20% in women with non-specified breast cancer stage at diagnosis [1]. Breast cancer is more frequently diagnosed in French-speaking Switzerland and in Ticino than in German-speaking Switzerland, where mortality rate is higher [1]. Policies for breast cancer screening are decided by cantonal authorities, and according to the same source, all French-speaking cantons (Fribourg, Geneva, Jura, Neuchâtel, Valais and Vaud) have a systematic screening program at their disposal, which will also soon be available in Ticino. On the other hand, in Swiss-Germany, only Bâle-ville, Berne, Grisons, Saint-Gall and Thurgovie (5 out of 18 German-speaking cantons) offer this system. For these reasons, in Ticino and French-speaking Switzerland, early diagnosis is more frequent, improving survival compared to the German-speaking cantons.

Although almost 80% of the patients undergo a breast-conserving surgery [3], mastectomy stays an important part in the management of breast cancer. Some authors showed that nowadays, this option is more frequently chosen by patients than before: increasing its rate from 31% in 2003 to 43% in 2006 [4], especially in young women [5]. There is an increase in prophylactic mastectomies as well, partially due to the "Angelina Jolie Effect" [6], but also due to the greater use of genetic tests revealing mutations suggestive of breast cancer development, particularly in young women with a family history of breast cancer. In France, where breast reconstruction (BR) is covered by health insurances, as it is in Switzerland, more than 80% of women with mastectomy choose to undergo a BR [7].

This study focuses on 4 types of BR, each one being a 3-step procedure: Deep Inferior Epigastric Perforator (DIEP) flap, Tissue Expander followed by Implant (TE/I), pedicled Latissimus Dorsi flap with or without tissue expander and implant (LD +/- TE/I).

First, the main reconstructive surgery is performed (DIEP, TE, LD) to reconstruct the shape and volume of the breast. The tissue expansion procedure followed by implant consists of the implantation of a tissue expander, into which physiological serum is gradually injected, in order to allow tissues to expand and making possible the insertion of a prosthesis. DIEP is an autologous reconstruction procedure in which a perforator flap based on epigastric perforating vessels, is used to reconstruct the breast. This flap is transferred as a free flap in the mastectomy site and anastomosed to the internal mammary vessels. The advantage of this method is the conservation of muscles, in contrast to the pediculated latissimus dorsi method implicating a musculocutaneous flap. The latter is called "pediculated", because, due to the proximity to the mastectomy site, it can be turned to cover the defect without necessity of free transfer and microsurgical anastomosis. Despite its shorter and less challenging procedure when compared to the DIEP, it retains a lower skin match, as long as abdomen skin resembles breast skin more than back skin does.

Further procedures, either on the reconstructed breast or on the other side, can be performed to improve the final breast contour and symmetry. Options for the reconstructed breast include lipofilling/fat grafting (removal of fat, from either the saddlebags or inner thighs, and

injection into the breast) or eventually flap volume enhancement (by tissue expander/implant behind the flap or by fat grafting). Controlateral healthy side can be augmented, reduced or lifted. The last step is the nipple reconstruction and tattoo for the aureola, which can eventually include lipofilling, particularly in prosthesis-based reconstructions. After these different stages of breast reconstruction, it is the patient's satisfaction that will end or not the operation cycle. Indeed, as long as the patient is uncomfortable with the breast appearance, the reconstruction is not considered over.

Reconstruction may be immediate (at the same time as the mastectomy) or delayed (6 or 12 months later). A review of literature based on 49 articles [6] showed that women who underwent radiotherapy should avoid an immediate reconstruction in favour of an autologous delayed reconstruction. This is because the tissues are more difficult to expand during radiotherapy, while complications are more frequent in prosthesis-radiotherapy procedures [7].

Breast reconstruction costs have been widely addressed in literature, but the final results are very different depending on the study and many criteria are likely to influence the cost. In Switzerland, to the best of our knowledge (no articles were detected on PubMed using search keywords "cost" "breast reconstruction" "Switzerland") the cost has not been yet studied and it remains impossible to estimate without further investigations.

The remuneration system of hospitals in Switzerland is based on the SwissDRG system (Swiss Diagnosis Related Group). Each stay in a hospital is classified into a group of pathologies and a number of points (= cost weight) is attributed to each group. This number is based on several criteria, such as main diagnosis, secondary diagnosis, treatments, etc. The remuneration of each hospital in swiss francs (CHF) is the result of the cost weight multiplied by the base rate. The base rate, currently around 10'000 CHF, is reviewed each year to adapt it closer to the cost of stays [8]. The remuneration of ambulatory medical care is based on the TARMED system. In the same way as for DRG, each medical act corresponds to a number of points. The monetary value of the point is frequently re-evaluated by the canton. This value is different in each canton: Vaud and Fribourg are the two most expensive cantons in Switzerland.

We used these data to assess and critically analyse how much the swiss healthcare system – and, for extension, insurances - pays for different types of reconstructions performed at the University Hospital of Lausanne (CHUV) in Vaud.

Methods

All hospitalized patients in the Reconstructive Surgery unit at the University Hospital of Vaud in Switzerland (CHUV) who underwent a total breast reconstruction by DIEP, LD +/- TE/I and TE/I from January 2012 through December 2015, were included in this study. This retrospective analysis was based on 76 women's breast reconstruction.

Using the hospital digital database, all medical details, from surgical procedure to complications and final outcomes were collected. The medical encoding and archiving unit supplied information concerning the DRG and the cost-weight of each hospital stay. With these data, we were able to calculate the amount invoiced to the health insurance: weight cost multiplied by the base rate. The base rate in 2012 and 2013 was 10'400 CHF and in 2014 and 2015: 10'350 CHF. We added outpatient interventions to this to obtain the total cost of each

type of reconstruction. The number of required operations, the total operation time, and the duration of the main surgeries were also statistically compared.

GraphPad Prism 7 (software Inc, La Jolla, USA), were used to conduct statistical analyses. Significance was expressed as * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Ethics

All the patients signed informed consent at on the use of their data for research purpose after their admission.

Results

The study followed up 72 female patients over a 2-and-a-half-year period after their first breast reconstruction intervention. All patients were successfully treated: 63.89% were with the DIEP technique, 16.67% with TE/I, 9.72% with LD and 9.72% with LD + TE.

Distribution of patient ages was homogenous, among groups, without statistically significant differences (table 1). Similarly, no difference in the number of procedures was detected among implant-based and autologous reconstructions.

TE/I demand 3.72 ± 0.47 operations (ave \pm SEM), while DIEP demand 2.97 ± 0.17 operations (ave \pm SEM), LD 2.86 ± 3.67 (ave \pm SEM), and LD+TE/I 3.57 ± 0.53 (ave \pm SEM).

Operative time was expected to be higher in DIEP reconstructions. DIEP took on average 575.2 ± 29.28 minutes (ave \pm SEM), TE/I 358 ± 89.46 (ave \pm SEM), LD 423.3 ± 44.54 (ave \pm SEM), and LD+TE/I 415.6 ± 56.65 (ave \pm SEM).

Concerning duration in months of the reconstruction, no significant difference was present among the interventions, ranging between 14.56 and 19.75 months.

Healthcare costs, which represent the key investigation of our study, showed that DIEP reconstructions were significantly less expensive than TE/I (**). No other significant differences in costs among the other reconstructions were noticed. DIEP costs on average $29'728 \pm 1'892$ CHF (ave \pm SEM), while TE costs $44'313 \pm 5'553$ CHF (ave \pm SEM), LD $29'813 \pm 3637$ CHF (ave \pm SEM), and LD + Prosthesis $37'688 \pm 4'840$ CHF (ave \pm SEM).

As general impression, complications occurred more frequently during implant-based reconstructions than autologous reconstructions (table 2). We also observed that DIEP autologous reconstructions required fewer revision surgeries than TE/I (17.39% et 33.33% respectively). In the TE/I group, 4 women suffered from capsulitis requiring revision surgery in the 2 years following their first intervention. In the DIEP group, revision surgeries were conducted following 3 necrosis (one of which also had an associated infection), 2 hematomas and 2 thrombosis. Another woman treated by DIEP suffered from partial necrosis, which could be treated conservatively without surgery. Regardless of the reconstruction, all the patients who suffered from infection had a BMI greater than 30, though we were unable to find any significant association between infections and BMI. We were also unable to obtain significant data on risk factors for breast reconstruction complications, resulting in the limited number of complications we studied. Risk factors that we did explore were pre-surgical radiotherapy, smoking and diabetes, as well as BMI.

Discussion

This study sought to improve the cost-effectiveness of breast reconstruction by investigating the cost of various techniques.

Statistical analyses indicated that DIEP was significantly less expensive than TE/I, which supports other articles published [9,10], while others found that the opposite is also true: in Holland, the medical cost (including those caused by complications) of DIEP was 17'351€, 9'561€ for LD + IMPLANT and 15'690€ for TE/I [11]; in the USA, the total cost (including complications) of DIEP is as high as 23'120.49\$ and 22'739.91\$ for TE/I [12]; and in the UK, excluding the cost of complications, DIEP cost 9'144£, LD+IMPLANT 6'654£ and TE/I 3'427£ [13]. Unsurprisingly, due to the high economic status and general pricing of Switzerland, these interventions are costlier here than in other European countries, such as the Netherlands and UK, as well as in the USA [11–13]. Analysing data, we could detect that the first surgical step in DIEP intervention (free flap transfer) costs more than the first TE/I (expander insertion). As a matter of fact, the first procedure needs microsurgical skills for optimal anastomoses quality. Those anastomoses are very important to avoid the necrosis of the flap, which is fairly typical of DIEP. This tendency rapidly inverts in the second step procedures. In fact, the second procedure in the DIEP group generally constitutes minor surgeries (lipofilling, lipoaspiration or contralateral breast reduction, symmetrizing mastopexy), whereas the second intervention in the TE/I group is more extensive due to the withdrawal of the expander and the insertion of the permanent prosthesis. Furthermore, women that have undergone a reconstruction with an implant require an additional surgical procedure 10-15 years after the intervention to replace the implant. Importantly, this was not taken into account in our study, but it needs to be underlined for the direct impact on the total cost. Prosthesis changes imply supplementary interventions over time, potential surgical risks and further paramedical costs for patients and social consequences (work leave, travel expenses). It should also be noted that the prosthesis might incur into capsular contracture. This affects 2.8 to 45% of women [14–17], so for our study, 0.2 to 5.4 women would be expected to have to undergo another intervention prematurely. Published research does not agree on when this contracture occurs: some studies suggest it occurs relatively early with 92% of cases arising in the first year post-operation [14], while other studies suggest an incidence curve plateauing at 8 years after the intervention [18]. Another complication of procedures involving prostheses that can require further surgery is implant shifts or malrotations. This further increases the total cost of this type of reconstruction. In our study, 33,3% of patients with an implant had to have revision surgery due to complications, which is a similar figure to previous research [17]. Our study did not take these costs into account, as the DRG system was introduced to Switzerland in 2010 only, thus the data required to estimate the costs of these interventions could not be obtained. Additionally, this study did not take into account the paramedical costs associated with reconstruction, such as transport costs and work leave, or quality of life after the intervention.

The number of interventions allowing a completed reconstruction is not significantly different from one reconstruction technique to the next. This can be an important factor to communicate to patients when they are offered these options. The operation time, on the other

hand, is significantly greater for DIEP compared to TE/I reconstructions, which can also influence patients' choice of procedure.

In literature, the rate of secondary surgery for complications is higher in TE/I than autologous breast reconstruction interventions [9,10,16,17]. Our data seem to confirm these reports, and may explain the observed differences in costs. Aesthetic outcomes were not evaluated in present study. However, particularly when radiotherapy is used on the breast autologous reconstruction can guarantee a better breast contour and tissue quality [7].

As far as total operation time is concerned, DIEP takes significantly longer than the techniques involving the fitting of a prosthesis, due to the first intervention being more complex than it is with TE/I.

The global reconstruction time did not differ among groups. Indeed, after the first intervention, there is a waiting time of 3 to 6 months before the symmetrisation procedure, and a further 3 months before the nipple reconstruction. It is important to mention that the duration of hospitalisation does not affect the costs of stay, as the DRG is determined by the intervention and not by the number of nights spent in hospital.

As Sgarzani et al. stated [19] « This mutilating procedure [mastectomy] is a traumatizing event, and many psychological disorders have been linked to this surgery in the literature [20–25] ». Aesthetics outcomes are one of the most important factors to be considered in breast reconstruction. Autologous (flap) reconstruction procedures are often associated with higher general and aesthetic satisfaction compared to implant-based reconstructions [19,26]. Damen et al. investigated the criteria influencing patients' choices, finding that the most important were the operation length (a shorter operation was more favourable), short- and long-term complications, such that “patients were less likely to choose options with increasing complication rates, both short- and long-term, and short-term complications were more important than long-term complications” [27].

Finally, the aesthetic result was also important, such that “autologous material and an excellent aesthetic result were generally the most important determinants in women's choices [27] ».

All the aforementioned points suggest that DIEP is the most suitable intervention as far as cost-effectiveness is concerned. However, it cannot be offered in every case as not every procedure is suitable for every patient. For example, smoking is a relative contraindication because the epigastric blood vessels are not healthy enough to provide blood to the graft in a DIEP procedure, as well as HTA, diabetes, high cholesterol, previous laparotomies. Moreover, a certain amount of abdominal spare fat is necessary to realize DIEP, making this procedure impossible in underweight women. The LGD procedure is an alternative for women with insufficient fat stores or for smokers (there is also no anastomosis in this procedure), but the breast volume obtained isn't always large enough, requiring, if necessary, a prosthesis to be added. Radiotherapy will worsen all procedures but is more an indication for autologous breast reconstruction, in opposition with prosthesis-based reconstruction. Moreover, patients report a higher level of satisfaction, aesthetically speaking, with autologous procedures, but the protocols are complicated, including microsurgery and requiring highly specialised surgeons.

We need to acknowledge that our study included a limited number of patients. As the DRG

system was installed only recently, the number of patients treated with reconstructive surgery under this system is limited. For this reasons, less frequent procedures like double reconstructions and immediate breast reconstructions by prosthesis were not included or analysed as they were insufficient in quantity to allow us to make effective and valid statistical comparisons. Moreover, it is likely that in the space of a few years, a larger sample will allow new comparisons to become significantly meaningful, such as number of interventions, number of complications, etc. Same concept may count for influence of tobacco, radiotherapy and obesity on complications.

A larger scale national study may be needed, including other crucial criteria, such as the quality of life, the complication rate and the patient's satisfaction.

Conclusion

This study expresses cost-benefits values in breast reconstruction in one University Hospital: the aim is not to limit patients' choice of intervention. In our opinion, patients must have the right to free choice in decisions concerning what happens to their body and changes to their physical appearance, especially when they must undergo procedures as devastating as mastectomies. Having said this, the intervention with the best cost-benefit ratio was the autologous DIEP flap breast reconstruction, which is generally recognised as the first choice in autologous breast reconstructions.

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Table 1

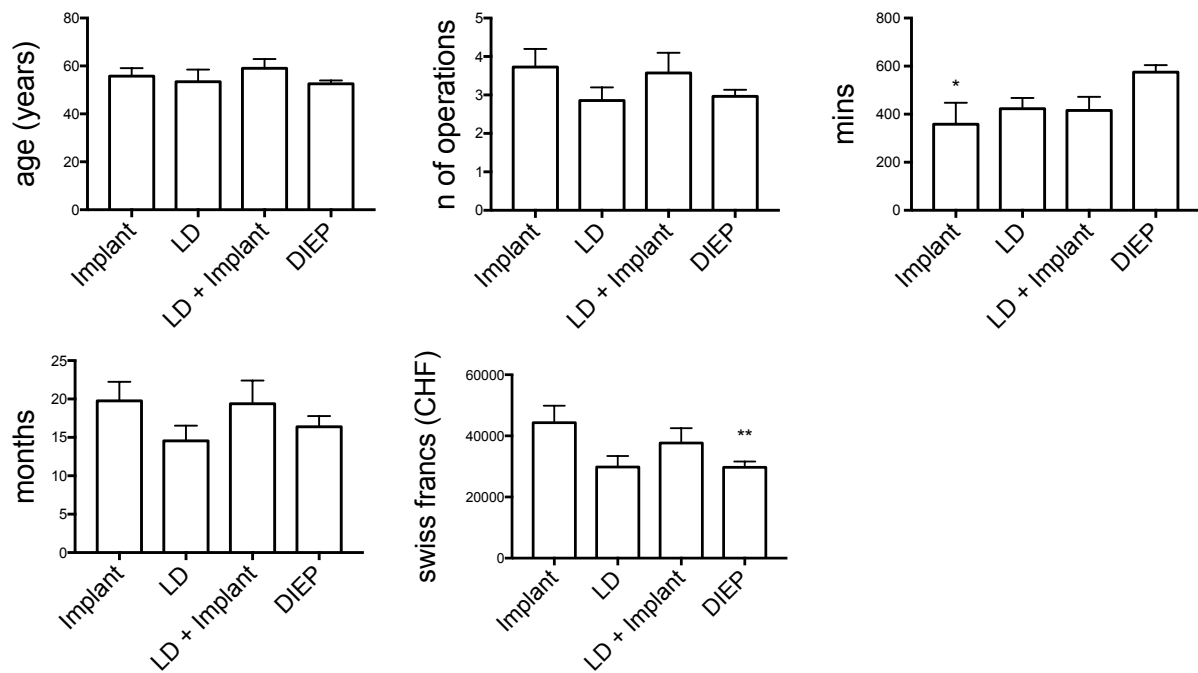


Table 2

COMPLICATIONS	IMPLANT (n=12)		LD (n=7)		LD + IMPLANT (n=7)		DIEP (n=46)		TOTAL (n=72)	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
infection	1	(8.33)	0	(0.00)	0	(0.00)	2	(4.35)	3	(4.17)
hematoma	0	(0.00)	0	(0.00)	1	(14.29)	2	(4.35)	3	(4.17)
capsulitis	4	(33.33)	0	(0.00)	1	(14.29)	0	(0.00)	5	(6.94)
seroma	0	(0.00)	0	(0.00)	1	(14.29)	0	(0.00)	1	(1.39)
necrosis	0	(0.00)	0	(0.00)	0	(0.00)	4	(8.70)	4	(5.56)
thrombosis	0	(0.00)	0	(0.00)	0	(0.00)	2	(4.35)	2	(2.78)
reoperation	4	(33.33)	1	(14.29)	1	(14.29)	8	(17.39)	14	(19.44)