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Rautalin, Mervi

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The Cost of Breast Cancer Surgery – Is the Money Spent Reflected on Health-related Quality of Life?

MERVI RAUTALIN[1], TIINA JAHKOLA[1] and RISTO P. ROINE[2]

[1]*Department of Plastic Surgery, Helsinki University Hospital and University of Helsinki, Helsinki, Finland;*
[2]*Department of Health and Social Management, University of Eastern Finland, Kuopio, Finland*

Abstract. *Background/Aim: Different treatment options of breast cancer (BC) are dependent on certain cancer- and patient-related features. The cost of treatment varies among patients. This study describes the cost distribution in the treatment of Finnish patients with BC for two years and relates the costs to important outcomes of modern BC treatment. Patients and Methods: Health-related quality of life (HRQoL) of 1,065 patients was measured prospectively at baseline, and 3, 6, 12, and 24 months thereafter with a generic (15D) and a disease-specific (EORTC QLQ C-30 BR23) HRQoL-instrument. Clinical data and costs of care were collected from hospital records. Patients were divided into four groups according to the surgical approach: breast-conserving surgery (BCS n=661), mastectomy (n=319), immediate reconstruction (IBR n=51), and delayed reconstruction (DR n=34), and the costs according to the clinic responsible for treatment: oncological-, breast surgery-, and plastic surgery unit. Total costs of care during follow-up are presented groupwise alongside HRQoL results. Results: The mean total cost for BC surgery was 6,015 Euros for BCS, 8,114 euros for mastectomy, 18,217 Euros for IBR, and 19,041 Euros for DR. BCS, IBR, and DR produced good HRQoL. Mastectomy patients had the lowest overall HRQoL and highest cost accumulation at the oncology unit. HRQoL of IBR and DR patients was similar. Conclusion: DR produces good HRQoL but generates the highest costs of care. If patients that require reconstruction could be identified earlier and offered IBR instead of mastectomy followed by later DR, the costs of care might be reduced.*

Correspondence to: Mervi Rautalin (ORCID 0000-0002-9427-7689), Department of Plastic Surgery, Helsinki University Hospital, Park Hospital, Stenbäckinkatu 11, PL 281, 00029 HUS, Helsinki, Finland. Tel: +358 94711, e-mail: Mervi.rautalin@hus.fi

Key Words: Breast cancer surgery, breast conserving surgery, breast reconstruction, health-related quality of life, quality of life, breast cancer health economics.

The economic burden of breast cancer (BC) is notably high in industrialized countries. BC is the most common cancer in women worldwide. The costs of cancer care form a large portion of the overall costs of health care. Radice *et al*. noted this over 20 years ago in a review and the notion is still apparent (1). The estimated number of new cancer diagnoses worldwide was the highest for BC in 2020, highlighting the importance of continuous research and evaluation of BC treatment (2, 3). A study from Finland compared costs of care between different cancer sites and reported that approximately one-fifth of all cancer costs resulted from BC. Thus, health-economic studies of BC are highly important (4).

The costs of BC care for the care provider consist roughly of two entities: the cost of surgical care and that of oncological treatment. Both comprise costs from diagnostics, outpatient clinics, procedures, medications, and hospital stay fees. All surgical and oncological treatments are individually tailored according to national guidelines and the specific characteristics of each patient's health, wishes, and the oncological framework (5). The surgical approach alternates from breast-conserving surgery (BCS) to mastectomy and more demanding reconstruction of the breast with either allogenous or autogenous materials. Breast reconstruction can be performed immediately at the first operation (immediate breast reconstruction; IBR) or later after primary surgery and oncological treatments (delayed reconstruction; DR) (6). Patients cannot be randomized for surgery as the choice of the surgical approach varies depending on the aforementioned individual features.

The assessment of the costs of surgical care for BC patients is demanding because of the variety of treatment options. The healing process may be associated with rising costs for instance in case of complications or recurrence of the disease. More complex surgery is prone to complications. Past studies have evaluated the costs from the care providers' point of view but data, especially on the total cost of surgical care, are

variable and analyses from the health care providers' point of view are still scarce (7). Quality indicators of treatments, recommendations concerning treatments and the standards of BC treatment centers as presented by the EUSOMA working group (European Society of Breast Cancer Specialists) recognize some inequalities in BC patients' treatment paths in Europe. A higher socioeconomic status in Europe is associated with earlier diagnostics and thus, probably better survival rates among BC patients (8, 9). A group of experts from different fields produced a guideline for health economic studies with the goal to standardize the quality of reporting of results and advising to perform cost-utility analyses (10, 11). The problem of randomization of treatments, however, sets a challenge for cost-utility analyses of BC surgical care.

Factors that diminish the quality of BC care (for example delays in diagnostics or problems in treatment accessibility) might be indicators of organizational problems rather than financial problems (8, 9). BC centers vary in resources and funding, and patients are not all equal in Europe or in the world regarding treatment accessibility. Comparison of treatment results and costs of care between different countries must be performed with caution, bearing in mind the dilemma of inequality of BC care accessibility. In Finland, municipalities are responsible for arranging and funding the health care system: services are funded by a multi-channel system, where funding is based on taxation, mandatory and voluntary insurance fees, patient- and employer fees, and donations (12). Services are available for everyone and the costs for the patients are the same irrespective of the extent of treatments received, unlike in some other countries (13-15). Different structures of funding of health care systems should be noted when comparing costs of BC care globally. It is a known fact that encountering economic difficulties also diminishes cancer patients' health-related quality of life (HRQoL) (16). HRQoL is an important outcome result of modern health care and is recommended increasingly to be evaluated throughout treatment paths (8, 9).

In this study, we focused on describing, from the health provider's perspective, the costs BC treatment generates during the first 24 months after diagnosis. The purpose was to evaluate the direct costs that different surgical treatments generate and relate those to both general patient characteristics and cancer-specific features, which define the paths of the individual treatment. In addition, HRQoL of the patients is discussed and related to costs. How the costs are composed, is important for the critical evaluation of different BC treatments' economic burden in the pressure of rising demands of treatments and the struggles societies encounter with ever-rising costs (17).

Patients and Methods

This study was approved by the Ethics committee of Helsinki University [Permission 68(June 11, 2008, 207/13/03/02/08)], and data collection was performed from Helsinki University Hospital records. A total of 1,065 patients with primary BC were recruited in the study from 2008 to 2015. The recruiting of patients was halted at times to allow other projects to do their recruiting simultaneously.

Patients were requested to fill in a written informed consent and two HRQoL questionnaires at the time of the first visit to the hospital (baseline) and 3, 6, 12, and 24 months later *via* mail. HRQoL questionnaires used in this study were the generic 15D and the cancer-specific EORTC QLQ C-30 BR-23. Both are well-established questionnaires and produce information about general health status and specific details about health and different symptoms (18, 19).

Clinical data on patients' general health, comorbidities using the Charlson index scoring system, and smoking status were collected from patient files (20, 21). The method of surgery was identified based on the Nordic Classification of Surgical Procedures (NCSP) codes used in files and double-checked by reading all patient records. Patients were divided into four mutually exclusive groups: BCS (n=661), mastectomy (n=319), immediate reconstruction (IBR, n=51), and delayed reconstruction (DR, n=34). The course of recovery was studied in more detail: complications, repeated surgical procedures, and later corrective surgery during 24-month follow-up were recorded.

Data on costs for the care provider were collected from the ECOMED-database from baseline to 26 months. This was done to cover all costs of care in case an operation was performed near the end of the 24-month follow-up. Costs were grouped depending on department: oncological, breast surgery (responsible for BCS and mastectomy), or plastic surgery unit (responsible for IBR and DR). All non-cancer-related costs were excluded from this analysis.

Results

Surgical approach and patient characteristics. BCS was performed for most of our study group, n=661. This group included both resection of the breast and oncoplastic resection techniques (no pedicular flaps). Three patients had an additional contralateral side reduction mammaplasty as corrective surgery for balancing reasons later after oncological treatments.

Mastectomy was performed primarily in 353 patients, of whom 34 received a DR within our study period of 24 months thus, constituting our DR group. Thus, the initial mastectomy group was n=319. Contralateral side mastectomy for balancing reasons was performed in 3 patients and one contralateral side reduction mammaplasty during follow-up.

IBR was performed in 51 patients: of the autologous flaps 20 were microsurgical (7 Deep Inferior Epigastric Artery Perforator DIEP, 9 Transverse Rectus Abdominis Muscle TRAM, 4 Transverse Musculocutaneous Gracilis TMG) and

Table I. *Patient characteristics*.

	Breast conserving surgery	Mastectomy	Immediate reconstruction	Delayed reconstruction
Mean age in years at baseline (range)	60.9 (34-85)	59.9 (24-89)	48.5 (25-64)	50.7 (31-74)
Active smoking n (%)	59 (8.9)	40 (12.5)	5 (9.8)	3 (8.8)
Charlson index ≥2 n (%)	50 (7.6)	45 (14.1)	5 (9.8)	2 (5.9)
Axillary clearance n (%)	173 (26.2)	195 (60.9)	19 (37.3)	15 (44.1)
Encountered complication n (%)	76 (11.5)	40 (12.5)	17 (33.3)	6 (17.6)
Grade 3 n (%)	166 (25.2)	145 (45.3)	25 (49)	12 (35.3)
T ≥2 n (%)	138 (21)	183 (57.2)	19 (37.3)	12 (35.3)
N ≥2 n (%)	40 (6)	73 (22.9)	3 (5.9)	1 (2.9)
M ≥1 n (%)	2 (0.3)	9 (2.8)	0	0
Radiation therapy n (%)	648 (98.2)	157 (49.1)	17 (33.3)	17 (50)
Chemotherapy n (%)	259 (39.2)	211 (65.9)	32 (62.7)	21 (61.8)
Endocrine treatment n (%)	463 (70.2)	239 (74.7)	34 (66.7)	30 (88.2)
Targeted therapy n (%)	59 (8.9)	47 (14.7)	7 (13.7)	6 (17.6)

CR: Complete response; PR: partial response; SD: stable disease; PD: progressive disease.

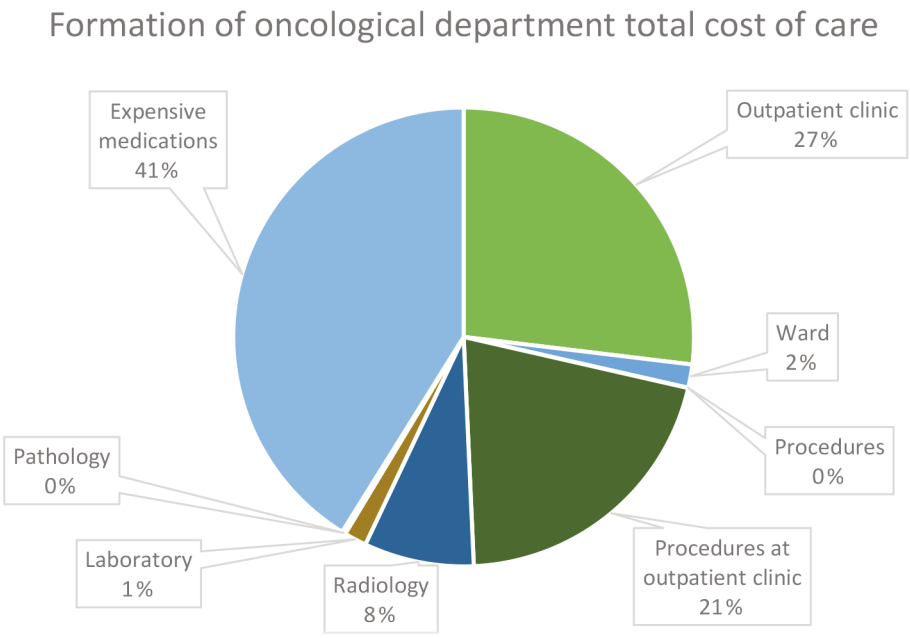

Figure 1. *Oncological department cost distribution, mean (n=1,004).*

19 pedicled Latissimus Dorsi LD (10 with and 9 without an implant). Allogenous procedures (12 patients) were performed with expander implants resulting in more than one procedure, where the expander was eventually replaced with a permanent implant.

DR was performed in 34 patients: 15 microsurgical (8 DIEP, 6 TRAM, one Lumbar Artery Perforator) and 10 pedicular (LD) flaps, 3 implants, and 6 fat graftings.

During follow-up, 16 (1.5%) patients died. One patient died within 3 months after surgery never reaching cancer treatments. Thirty-two (3%) patients encountered a recurrence. Patient characteristics are presented in Table I, where Charlson comorbidity index 2 or higher indicates comorbidity burden and Grade 3 and TNM classification for those with higher disease burden (T2 or higher, N2 or higher, or M1 or higher).

Table II. *All patients' oncological treatment costs in Euro (mean) depending on disease status during follow-up. Highest cost in bold.*

	All patients n=1,004 Mean (SD)	Patients with M1 at baseline n=11 Mean (SD)	Patients with recurrences n=32 Mean (SD)	Patients who died during follow up n=15 Mean (SD)
Total cost	8,521 (10,424)	**41,602** (37,493)	14,690 (12,895)	18,014 (26,739)
Outpatient clinic	2,239 (1,658)	**5,578** (3,949)	3,834 (2,693)	3,131 (3,330)
Ward costs	136 (807)	733 (1,335)	994 (2,817)	**1,979** (3,880)
Procedures	1.8 (40)	0	32 (182)	**69** (266)
Outpatient clinic procedures	1,723 (935)	1,515 (1,147)	**2,185** (1,121)	1,725 (1,418)
Radiology	642 (749)	**3,381** (1,895)	1,552 (1,228)	1,561 (1,761)
Laboratory	131 (165)	**496** (279)	307 (252)	276 (279)
Pathology	21 (114)	109 (209)	151 (374)	**176** (377)
Expensive treatments	3,423 (8,010)	**28,809** (32,319)	5,179 (8,369)	8,555 (21,294)

The costs of oncological care. Cost data were available from the ECOMED database for 1,004 patients' oncological treatments during the study period, data were missing for 61 patients. The distribution of mean costs for all BC patients during the study period at the oncological unit is presented in Figure 1. The mean total cost was 8,521 Euros per patient (SD 10,424). Patients had a mean of 31 visits at the outpatient clinic, they spent a mean of 0.3 days at wards, had a mean of 19 outpatient clinic procedures (this includes radiation therapy), and received expensive medications (including Herceptin or other targeted therapy other than standard Chemotherapy) 4.2 times.

If patients encountered a recurrence, their expenses at the oncological unit increased to a mean of 14,690 Euros. Those who died during the follow-up incurred a mean of 18,014 Euros of expenses. The costliest patient group comprised those who had distant metastases already at baseline. The costs of their oncological treatments increased to a mean of 41,602 Euros during the follow-up (Table II).

The cost of surgical care. Data on costs of surgical treatment were missing for 9 patients in the IBR group, 3 in the DR group, 37 in the mastectomy group, and 70 in the BCS group. BCS was the least expensive treatment from a surgical point of view; mastectomy was approximately a mean of 2,000 Euros more expensive. The most expensive treatment was DR. The difference between IBR and DR total costs was small, less than 1,000 Euros. Specifics of surgical costs and numbers are presented in Table III and Figure 2. The total costs of oncological treatments are presented also groupwise in Table III.

Mastectomy patients had more frequent outpatient visits than BCS patients. The range was 1 to 53 visits (mean 13.1) with 0 to 50 small procedures (mean 11.2). The costs of outpatient clinic procedures ranged from 0 to 1,200 Euros in mastectomy patients and from 0 to 840 Euros in BCS.

Health-related quality of life. During follow up, the response rate stayed at a high level: at 3 months 93%, 6 months 95%, 12 months 94%, and 24 months 90%.

Both the generic and disease-specific HRQoL instruments showed a drop in HRQoL after baseline, but HRQoL started to recover as time went by. Mastectomy patients had the lowest overall HRQoL at baseline, which remained the lowest also at 24 months. DR patients had the highest HRQoL during the whole follow-up as measured with 15D but with EORTC the last 24-month measuring point revealed a drop in HRQoL. The mean delay for initial DR was 20.5 months. Otherwise, the results were quite similar with both instruments for different groups as presented in Figure 3. A higher disease burden was reflected on HRQoL: N- status affected HRQoL negatively according to both instruments, $p<0.001$ at 3 months. EORTC M-status affected HRQoL at 24 months ($p=0.032$). Receiving chemotherapy affected HRQoL mostly at 6 months ($p<0.001$) and traces of this were still seen at 24 months ($p=0.013$). Axillary clearance affected negatively HRQoL throughout the follow up ($p<0.01$); however, a recurrence did not affect HRQoL.

Discussion

BC research has traditionally focused on the endpoints of disease-free survival, overall survival, and tumor response. In modern treatment of BC, it is advisable to focus not only on the oncological quality of care but also on patient-experienced results that provide good HRQoL. Resources should be targeted on care that is proven to be effective in all these aspects.

What is costly and what is not? We know from our previous studies that the quality of life varies in relation to time, which can be seen as a natural course of encountering BC and recovering from it (22). We also know that there is little difference between IBR and DR patients' HRQoL in the

Table III. *Surgical costs, oncological total cost, and specifics of surgical cost formation for different groups in Euros, mean (SD) during follow up. Highest cost in bold.*

	BCS (n=591) Mean (SD)	Mastectomy (n=282) Mean (SD)	IBR (n=42) Mean (SD)	DR (n=31) Mean (SD)
Total cost of surgery	6,015 (2,901)	8,114 (4,020)	18,217 (9,355)	**19,041** (10,695)
Total cost of oncological treatments	7,460 (9,217)	**10,746** (12,734)	8,102 (8,362)	9,504 (9,435)
Cost of operation theatre procedures	2,572 (1,428)	3,047 (1,593)	8,560 (5,069)	**9,381** (4,996)
No. of surgical procedures	1.3 (0.8)	1.8 (1.5)	3.3 (2.7)	**3.5** (3.4)
Ward costs	714 (1,072)	1,264 (886)	3,999 (2,682)	**4,162** (3,968)
Days spent at wards	1.1 (1.8)	2.2 (3.3)	**7.7** (4.9)	7.2 (6.2)
Outpatient clinic costs	656 (641)	1,235 (886)	**1,894** (992)	1,747 (1,027)
No. of visits at outpatient clinic	6.4 (5.7)	13.1 (8.6)	**19.7** (9.4)	18 (9.8)
Outpatient clinic procedure costs	117 (190)	38.6 (163)	**540** (506)	345 (585)
No. of outpatient clinic procedures	4 (4.9)	11.2 (8.1)	**16.9** (8.4)	15.5 (9.5)

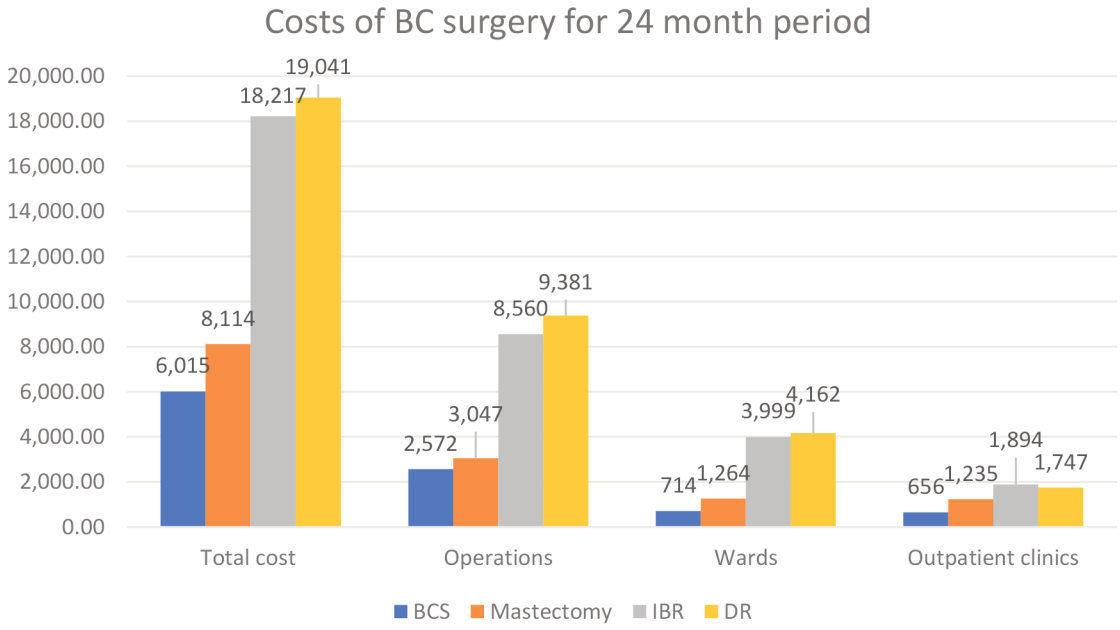

Figure 2. *Surgical cost distribution presented by groups, mean euros. Twenty-four-month follow-up period.*

time frame of two years (23). As previous studies and treatment guidelines suggest, BCS produces good HRQoL and satisfies patients. Their body image is better and different symptoms are more seldom in comparison to mastectomy patients. Mastectomy patients have the lowest scores on HRQoL and the highest cost of oncological treatments, which both could reflect a higher disease burden (24). In our study, mastectomy patients also had to visit more frequently the outpatient clinics of the breast unit for seroma aspiration. In comparison, 50% of mastectomy patients avoid going through radiation therapy, whereas BCS is invariably followed by adjuvant radiation therapy, thus both patient groups have the inconvenience of having to visit the hospital several times.

The highest cost of surgical care for DR patients should be a focus in future studies. Based on the HRQoL results, they seemed to be doing quite well, which raises the question of whether they should be offered IBR more often to avoid the additional costs of two rounds of BC surgery and reconstruction. The challenge is to identify the patients that are prone to seek later surgical correction of BC surgery. With the psychological burden of having cancer, patients are not always ready to deal with heavier surgical procedures with more risks and are keener to just get rid of the cancer

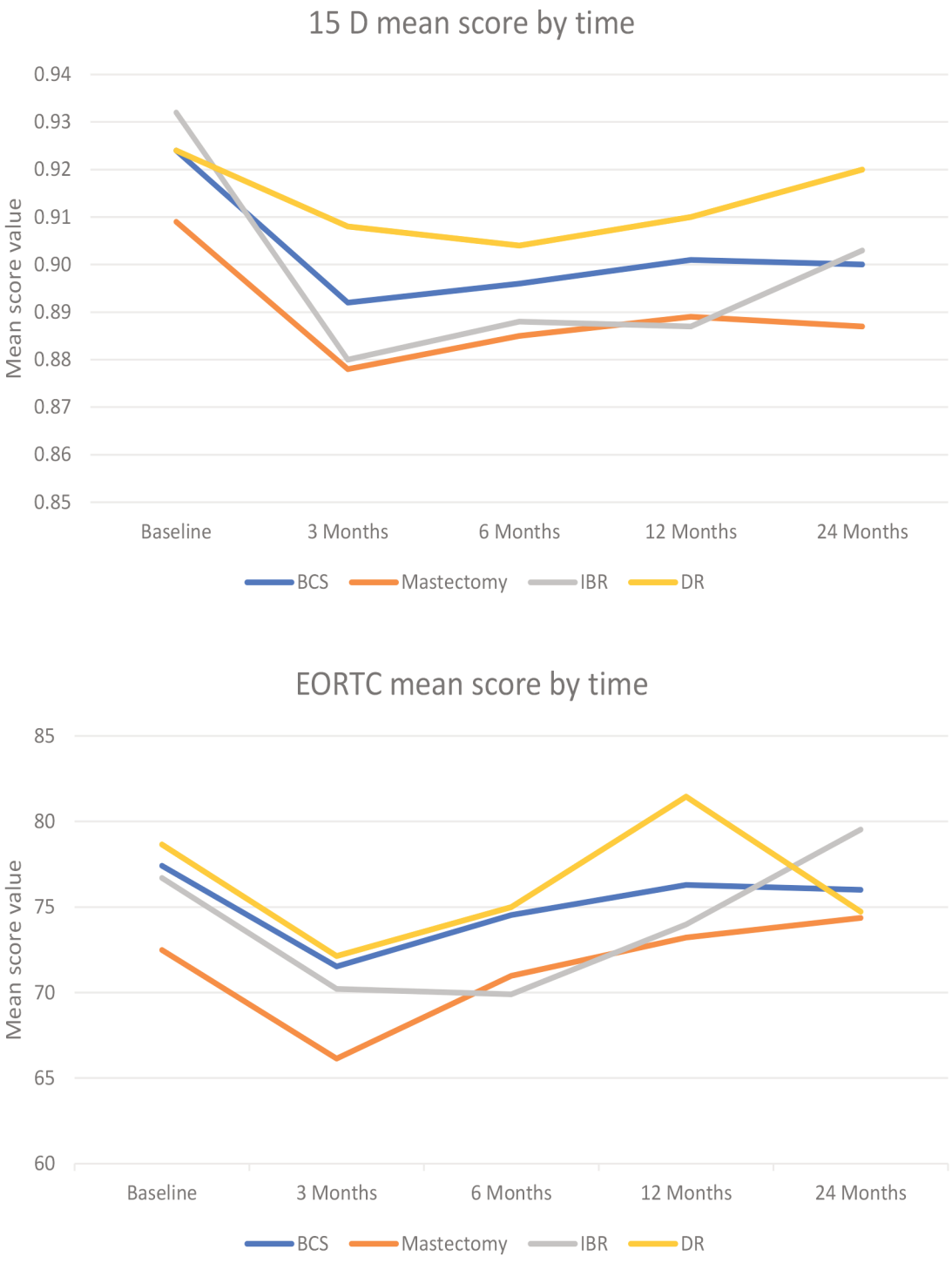

Figure 3. *Mean health-related quality of life scores by time in different groups.*

as soon as possible. The wish for reconstruction often rises a year after primary breast cancer treatment. With proper education, we might be able to better introduce these options to the patients and produce good HRQoL with fewer operating sessions thus, diminishing the costs of care. However, the moderate 1,000 Euros difference in treatment costs between IBR and DR is not a reason to push any patient to IBR against her wish.

This study does not consider the costs patients pay themselves nor the productivity losses due to absence from work. A recent study assessed total costs of BC in different disease states with the inclusion of these indirect costs and costs from primary health care noting that the total costs of BC care accounted for about half of the total costs (7). These might be substantial factors in the whole healing process as the costs of the surgical approach itself do affect the costs for the patient in our country. They pay fees for hospital days spent at the ward and outpatient clinic visits, but not any fees for the surgical procedures. Thus, it does not matter from an economical point of view to the patient, whether she undergoes a resection or a reconstruction. Also, it is very difficult to assess the psychological burden patients face: a situation where you are losing a part of your body that is generally considered a part of a person's sexual identity and related to the experience of gender, then adapting to the loss *versus* later correcting this by replacing a sensitive part of your body with a different part with a different sensational and visual outcome.

The time perspective in this study was chosen so we could follow up DR patients during their first 24 months and analyze their costs alongside patients with a final surgical approach in the primary surgical session. Longer follow-up might reveal more patients going through DR and differences in HRQoL. A large study with different surgical approaches to BC and a 10-year follow-up in the Netherlands indicated that BCS produces high HRQoL with lower costs and reconstruction with higher costs outperforms mastectomy like in our study (25).

When considering breast reconstruction, the aim is to enhance HRQoL, not survival, thus basing health budgets solely on direct costs is not advisable. In terms of HRQoL, it is imperative to recognize that reconstruction produces good HRQoL, as does BCS, and is a good option in BC treatment even though it is costly.

Conclusion

Breast cancer surgery that preserves the breast produces good HRQoL and the treatment costs for care providers are the lowest. Breast reconstruction produces good HRQoL somewhat later and, if performed in a delayed setting, the costs of care are slightly higher than in an immediate setting. Careful patient selection produces efficient and high-quality health care.

Conflicts of Interest

The Authors declare no conflicts of interest regarding this study.

Authors' Contributions

All Authors participated in the design, performed this study, and contributed to the writing of this article.

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