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Research Article

Oncological and Surgical Outcomes of Goldilocks Mastectomy at a Tertiary Public Hospital in Johannesburg, South Africa

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ABSTRACT

Background: Breast cancer remains a significant health burden in South Africa, characterised by an increasing prevalence and significant barriers to access reconstructive surgery for affected women. The Goldilocks mastectomy, introduced as a minimally invasive reconstructive procedure, addresses cosmetic and psychological concerns in patients with limited access to formal reconstruction. This study evaluated surgical outcomes and margin status following nipple-sparing Goldilocks mastectomy at a tertiary public hospital in South Africa.

Methods: We performed a retrospective review of patients undergoing Goldilocks mastectomy at Helen Joseph Hospital between 2017 and 2024. Fifty patients underwent 95 mastectomies (predominantly bilateral for contralateral symmetrisation). Complications were graded according to the Clavien–Dindo classification. Margin status was obtained from histopathology. Logistic regression was used to explore factors associated with complications

Results: The median age was 45 years (IQR 39–53), and the median BMI was 28.5 (IQR 26.0–35.3). 10 patients (20%, 10/50) experienced postoperative complications. The most frequent complications were haematoma (4%, 2/50), nipple necrosis (4%, 2/50), fat necrosis (4%, 2/50), nipple epidermolysis (2%, 1/50), and wound dehiscence (2%, 1/50). Reoperation rate was 14% (n=7). Positive margins were observed in 12% (n=6), of whom 2 required re-excision. Increasing body weight was associated with higher odds of complications (OR 1.09 per kg, 95% CI 1.02–1.21; p=0.036); a strong association was also observed with positive margins, although estimates were imprecise (OR 67.6, 95% CI 4.44–3690; p=0.009).

Conclusion: This study in a public-sector cohort demonstrated that the Goldilocks Mastectomy offers acceptable oncological safety and complication rates, supporting its use in resource-constrained settings. Higher body weight was associated with increased complication risk, and thus careful patient selection is crucial.

Keywords: Goldilocks mastectomy, breast reconstruction, oncological outcomes, surgical complications, South Africa.

INTRODUCTION

Breast cancer is the most common malignancy among women worldwide, accounting for up to 6.6% of all cancer-related deaths.(1) In South Africa, it represents 20.8% of all female cancers, with rising incidence rates attributed to improved life expectancy and the effective management of infectious diseases such as Human Immunodeficiency Virus (HIV).(2) The increasing prevalence of breast cancer underscores the need for accessible and effective treatment options, especially in settings where advanced reconstructive techniques are limited. The Goldilocks Mastectomy was first described by Richardson and Ma in 2012, as a middle-ground solution for patients who were not candidates for or declined formal breast reconstruction.(3) The procedure involves a skin-sparing mastectomy with preservation of the subcutaneous fat and de-epithelialised skin flaps to create a small breast mound, eliminating the need for implants or autologous tissue.(3,4)

Studies evaluating the outcomes of Goldilocks Mastectomy indicate a complication rate of between 6% and 20%.(3–5) A major downside of this procedure is a poor cosmetic outcome.(4,6) In an effort to improve the cosmetic outcome, some authors have performed this procedure as a nipple sparing mastectomy.(7) At our institution, we adopted the nipple sparing variant of the procedure.

The aim of the study was to describe the oncological safety of the Goldilocks Mastectomy procedure by reviewing the surgical excision margins. The rest of our findings were graded according to the Clavien-Dindo classification of surgical outcomes. This model was described by Clavien, Sanabria and Strasberg in 1992 in order to standardise the reporting of surgical outcomes.(8)

METHODS

We conducted an eight-year retrospective review of patients who underwent the Goldilocks mastectomy at Helen Joseph Hospital, a tertiary public hospital in Johannesburg, South Africa, between 01 January 2017 and 31 December 2024. Ethical approval was obtained from the University of the Witwatersrand Human Research Ethics Committee under Clearance Certificate No. M191049.

Patient records were reviewed to extract demographic data, including age, race, employment status, smoking history, weight, height, and BMI. Comorbidities such as hypertension, diabetes, HIV, asthma, and rheumatoid arthritis were documented. Surgical outcomes, including complications, were graded using the Clavien-Dindo classification, which categorises complications based on severity and the need for intervention. Oncological outcomes were assessed using histopathological reports. Surgical margin status was recorded as positive or negative based on histopathological assessment. As margin status was determined postoperatively by the pathologist on receipt of the surgical specimens, all positive margins represented microscopic (R1) involvement. Macroscopic (R2) margin involvement, defined as grossly positive intraoperative margins, was therefore not observed in this cohort.

Data were analysed in R version 4.4.1. Descriptive statistics were used to summarise patient characteristics, comorbidities, surgical outcomes, and oncological margin status. Continuous variables such as age, BMI, weight, and height were expressed as medians with interquartile ranges (IQR). Categorical variables were expressed as counts and proportions. The Wilcoxon rank sum test and Fisher's exact test were used to assess differences in characteristics between patients with and without complications. Univariate logistic regression models were first utilised to evaluate potential predictors of complications. Variables with a p-value < 0.2 in univariate analysis were considered for inclusion in a multivariable model. Stepwise variable selection based on the Akaike Information Criterion (AIC) was then applied to refine the final multivariable logistic regression model, which is presented with odds ratios (OR), 95% confidence intervals (CI), and p-values.

RESULTS

General characteristics

From 01 January 2017 until 31 December 2024, a total of 50 patients (96 breasts) underwent the Goldilocks mastectomy as the method of reconstruction during primary breast cancer surgery. The mean age at initial presentation was 45 (39-53) years. The median BMI at presentation was 28.5 (26.0-35.3). Four patients (8%) elected to have a unilateral procedure, and the remaining 46 patients (92%) underwent a bilateral Goldilocks Mastectomy procedure. Of the 46 patients who underwent a bilateral procedure, only one patient had bilateral breast cancer as an indication for bilateral Goldilocks Mastectomy. In patients without contralateral breast cancer, bilateral Goldilocks mastectomy was performed for contralateral symmetrisation, using the same mastectomy principles as for the oncologic breast. Smoking was noted in only 2 patients, accounting for 4% of the cohort. The degree of ptosis, as defined by the position of the nipple relative to the inframammary fold, was inconsistently documented across patient records. The median sternal notch-to-nipple areolar complex (NAC) distance of the studied breasts was 28.5 cm (IQR 26.0; 31.0), and the accompanying median NAC-to-inframammary fold distance was 11 cm (IQR 9.0,13.0). These measurements were used as surrogate anthropometric descriptors of breast morphology and vertical breast dimensions, rather than definitive measures of breast size or ptosis.

Comorbidities

Comorbidities are presented in Table 1. Twenty patients (40%) had at least one medical comorbidity. Hypertension was the most prevalent comorbidity, present in 11 patients (22%), followed by HIV in 5 patients (10%). Other comorbidities included diabetes, asthma, hypothyroidism, and rheumatoid arthritis. Three patients had more than one comorbidity.

Surgical outcomes

An overall (first operation and reoperation) complication rate of 20% was observed, with 10 of 50 patients experiencing a postoperative complication (Table 2). Each affected patient experienced a single complication. The complications observed included haematoma, nipple–areolar

Table 1. Comorbidities

Comorbidity *	n (%)
Hypertension	11 (22%)
HIV	5 (10%)
Diabetes	3 (6%)
Asthma	2 (4%)
Hypothyroidism	1 (2%)
Rheumatoid Arthritis	1 (2%)

*Three patients had more than one comorbidity

Table 2. Complication type

Overall Complication Rate	10/50 (20%)
Completion mastectomy	1 (2%)
Fat necrosis	2 (4%)
Haematoma	2 (4%)
Margin excision	1 (2%)
Nipple epidermolysis	1 (2%)
Nipple necrosis	2 (4%)
Wound dehiscence	1 (2%)

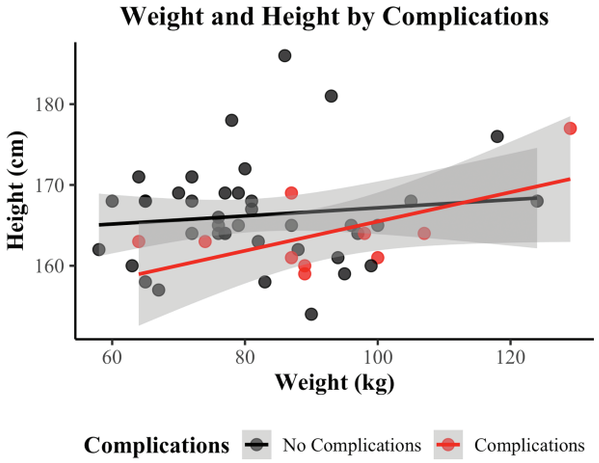

Figure 1. The association between weight and height, categorised by complications. Points represent individual observations. Regression lines indicate trends. Shaded areas show 95% confidence intervals.

complex (NAC) necrosis, epidermolysis, fat necrosis, and wound dehiscence. When stratified by laterality, eight complications occurred on the treatment side, while two occurred on the contralateral symmetrisation side. Two patients required reoperation for oncological reasons: one underwent completion mastectomy and one required margin re-excision, representing a 4% oncological reoperation rate. According to the Clavien–Dindo classification, seven patients experienced Grade IIIb complications, corresponding to an overall reoperation rate of 14%. Indications for reoperation included haematoma (n=2), nipple necrosis (n=2), wound dehiscence (n=1), margin re-excision (n=1), and completion mastectomy (n=1).

Factors associated with complications

The odds of a complication increased by 9% for every 1 kg increase in body weight (odds ratio 1.09 (95%); confidence interval 1.02-1.21; p=0.036). For every 1 cm increase in body height, the odds associated with a complication decreased by 18% (OR 0.82 (95%); CI 0.64-0.98; p=0.055). Although this is not significant at the conventional 5% level, it is notable. (**Figure 1).** The odds of having any complication were higher for patients with positive (involved) margins (OR 67.5, 95% CI 4.43-3 890; p=0.0011) compared with those with clear margins.

Oncological outcomes

Oncological outcomes were analysed on a per-breast basis. A total of 51 breast specimens were evaluated from 50 patients, as one patient underwent bilateral surgery for malignancy. Surgical excision margins were involved in six breast specimens (12%), while clear margins were achieved in 45 breasts (88%). Contralateral prophylactic mastectomy was performed in 45 breasts as a symmetrisation procedure; none of these specimens demonstrated malignancy on final histopathological assessment. Among the six patients (12%) with positive surgical margins, tumour staging was T2 in three, T1 in two, and T3 in one. In the case of patients with T1 tumours, management options were discussed and the decision to proceed with a mastectomy was based on patient preference. Three patients were lost to follow-up. However, a search of the electronic records across state hospitals revealed no subsequent follow-up visits, laboratory results, or oncological interventions for these patients, and no documented evidence of local recurrence during the study period.

DISCUSSION

Since its initial description by Richardson and Ma, the Goldilocks mastectomy has become a popular reconstructive option for patients not pursuing formal reconstruction. A critical gap in the literature, however, is the lack of studies specifically evaluating its oncological safety. Therefore, to provide a relevant clinical benchmark for our margin results, we contextualised them within the established outcomes of nipple-sparing mastectomy (NSM), the technical foundation upon which our institutional variant of the procedure is built.(9,10). This comparative approach is supported by the technical precedent set by Richardson and Aronowitz, who demonstrated the feasibility of preserving the nipple-areolar complex during a Goldilocks procedure.(7)

In 2021, Son *et al.,* compared rates of negative margins in 300 patients undergoing different forms of mastectomy for lobular carcinoma in situ (LCIS). They reported involved margin rates of 8.4% for radical mastectomy, 18% for skin-sparing mastectomy, and 12.7% for nipple-sparing mastectomy.(9) These findings are comparable to the positive margin rate observed in our study, where six patients (12%) undergoing Goldilocks mastectomy as a nipple-sparing procedure had involved margins. In contrast, Woodward *et al.,* reported a lower positive margin rate of 5.6% in a cohort of 105 patients undergoing nipple-sparing mastectomy.(10)

The complications of Goldilocks mastectomy have been documented in multiple studies. Richardson and

Ma reported a 8% complication rate in their cohort of 32 patients.(3) Similarly, Chaudhry *et al.*, in a study of 58 patents reported a 9.38% complication rate.(4) In the present study, 16% of patients experienced surgical complications, defined as wound- or procedure-related adverse events. This rate is higher than that reported in the above-mentioned studies but remains lower than the 20% complication rate reported by Mohammad in a study of 15 patients.(5) An additional 4% of patients underwent reoperation for oncological indications alone, namely margin re-excision and completion mastectomy, resulting in an overall complication rate of 20%. Our study also highlighted the role of an increased body weight and decreased body height in contributing to poor surgical outcomes. Although complications were not directly linked to a high BMI in this study, it supports the notion of an increased overall complication risk with higher BMI.(11)

In the original description by Richardson and Ma, the primary indication for Goldilocks mastectomy was for the older obese patient with severe comorbidities, limiting the use of more formal reconstructive methods.(3) In our institution, we expanded on the indications of this procedure by applying it to a younger population, as the average recorded age was 45 years in our study, compared with an average age of 61. 5 by Richardson and Ma's.(3) We also applied the procedure to patients with a lower average BMI of 28.5 compared with Richardson and Chaudhry, who recorded an average BMI of 30.3 and 33.7, respectively.(3,4)

In order to improve the cosmesis, we performed the procedure as a nipple sparing mastectomy in our unit, as was described by Richardson and Aronowitz in 2018.(7) This is a significant improvement to the initial description by Richardson and Ma in 2012.(3)

STUDY LIMITATIONS

As this was a retrospective study, we were unable to interview patients about their satisfaction with the cosmetic results of this procedure. Furthermore, the assessment of morphology and ptosis was limited by inconsistent clinical documentation. This study is also limited by selection bias and a small sample size; therefore, caution is advised when making any inferences.

CONCLUSION

This study in a public-sector cohort in South Africa demonstrated that the Goldilocks mastectomy offers acceptable oncological safety and complication rates, supporting its use in resource-constrained settings. Although we did not examine cosmetic outcomes in the current study, it represents a significant improvement over the original description, as it preserves the nipple-areola complex. The current study found that a higher body weight was associated with an increased risk of complications; thus, careful patient selection is important.

AUTHOR CONTRIBUTIONS

Dr Njabulo Dumakude collected and collated the data, performed data interpretation, and drafted the initial version of the manuscript.

Dr Adelaide Rooi conceptualised the study, performed the surgical procedures, and contributed to the writing and critical revision of the manuscript.

Dr Marietha Nel provided critical input into the writing, structuring, and intellectual content of the manuscript.

All authors reviewed and approved the final version of the manuscript

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