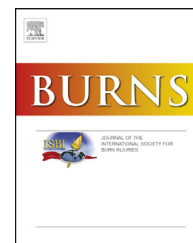


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Psychological and psychosocial functioning of children with burn scarring using cosmetic camouflage: A multi-centre prospective randomised controlled trial

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ARTICLE INFO

Article history:

Accepted 19 April 2013

Keywords:

Child

Burn

Scarring

Cosmetic camouflage

Quality of life

Socialisation

Self-concept

ABSTRACT

Background: Burns leave patients with long-term physical scarring. Children with scarring are required to face challenges of reintegration into their community, including acceptance of an altered appearance and acceptance by others. This can be difficult given society's preoccupation with physical appearance.

Limited research exists investigating validity of cosmetic camouflage as a psychosocial intervention for children with scarring. This study investigated whether using cosmetic camouflage (Microskin™) had a positive impact on health-related quality of life, self-concept and psychopathology for children and adolescents (8–17 years) with burn scarring. **Method:** A prospective multi-centre randomised controlled trial was conducted across Australian and New Zealand paediatric hospitals. 63 participants (49 females, mean age 12.7 ± 2.1 years) were enrolled. Data points were baseline (Time 1) and at 8 weeks (Time 2) using reliable and valid psychometric measures.

Results: Findings indicate there were significant improvements in socialisation, school and appearance scales on the Paediatric Quality of Life Inventory and psychopathology scores particularly peer problems decreased. However self-concept remained stable from baseline throughout intervention use.

Conclusion: Cosmetic camouflage appears to have a positive impact on quality of life particularly socialisation. Cosmetic camouflage is a valid tool to assist children with scarring to actively participate socially within their communities.

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1. Introduction

It is well reported in the literature that the focus of burns research has progressed to include the long-term psychosocial

functioning of patients, both adult and child as survival from this serious injury is now a common outcome. However, research investigating the psychosocial aspects of burn shows a great deal of variance in specific research areas, methodologies, and results. Findings have been equivocal with some

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<http://dx.doi.org/10.1016/j.burns.2013.04.025>

showing this population struggle with long-term adjustment, reintegration and rehabilitation after the injury and subsequent scarring [1–3]; others highlight that they cope and adjust well [4–7]. Psychosocial functioning includes quality of life, self-concept, body image, social and emotional functioning, psychopathology such as behavioural difficulties and more significant diagnoses such as post-traumatic stress disorder (PTSD). These have all been studied to varying degrees within the burn literature. However, few studies have investigated how positive psychosocial adjustment is achieved or what interventions support patients to achieve positive long-term psychosocial functioning particularly related to scarring and an altered appearance. Some studies have explored the use of cosmetic camouflage [8], Cognitive Behavioural Therapy [9] and Social Skills Training [10]. The aim of the present study was to determine whether improving scar appearance for young people through the use of a cosmetic camouflage (Microskin™) would have a beneficial effect on psychosocial functioning particularly quality of life, behaviour, self-concept, and family dynamics.

Some studies have found that children with extensive burns report self-concept, body esteem and behaviour within the normal range or higher [4–7]. Lawrence et al. reported gender differences, with male burn survivors not differing from age-matched controls, but females reporting better body esteem than the comparison group [5]. Robert et al. found that within self-esteem, burn-injured children scored lower on physical appearance and athletic competence but higher than average on social competence [6]. Landolt et al. when investigating health-related quality of life and PTSD found that only social functioning was below the norm for burned children compared to healthy counterparts [11]. Sheridan et al. also examined quality of life of children surviving massive burns and found that most had satisfactory quality of life, however this study did not include a physical appearance component [12]. Similarly, Pope et al.'s comparison study found that young burn survivors reported a better quality of life than a control group suggesting survivors were able to reflect realistically about their injury and scarring, may be dissatisfied with their burned parts, but are positive overall about their quality of life and body-image [13]. It has been argued that this population place more emphasis on areas of they can control (e.g., academic performance) and less on domains out of their control (e.g., appearance) and therefore may have an overly positive self-regard which is used as a coping mechanism [7].

In contrast, other studies have found that burn-injured children and adolescents experience significant problems with quality of life particularly appearance [3], overanxious disorders and phobias, depressive symptoms and the presence of PTSD [2,14] which may be in the context of parental separation and/or dissociative responses during burn treatment [1] which can be painful and traumatic [15,16]. Overall, these studies suggest that the long-term effects of scarring and an altered appearance can impact greatly on quality of life and socialisation of this population as it is a reminder of the traumatic incident. They may be subjected to challenging social experiences including stigmatisation, staring and negative verbal remarks connected with the high importance placed on appearance in society [17,18].

Self-concept plays a significant role in mediating positive contributions of social support to the emotional and behavioural adjustment of young adolescents [19] and is particularly important when considering young burn survivors as social support predicts better self-esteem, more positive body image and overall adjustment in this population [20,21]. Abdullah et al. explored the link between visible scarring and self-concept for paediatric burn patients finding that as the number of visible scars increased, patient's scores for physical appearance and happiness and satisfaction decreased [21]. Other domains of self-concept were not affected [21]. It is well documented that people with disfiguring conditions experience challenges, anxiety, and difficulties in respect to social interaction: their visible difference has a profound psychological impact [18,22–24].

Negative responses to visible physical differences may include startled responses, stares, avoidance, unsolicited questions and comments, teasing, rude behaviour and bullying [25]. Self-consciousness and discomfort regarding their altered appearance or from others' responses may lead to angry, aggressive, inappropriate behaviours [26]. Strong relationships exist between self-concept, self-evaluation of physical appearance and affective states suggesting burn survivors whose physical appearance is marked by scarring may suffer from low self-concept and sad or depressed affect [6] and may also harbour feelings of guilt and responsibility regarding the injury which may further impact on their self-concept.

In summary, the review of the literature suggests some children with burns adapt to their changed appearance relatively positively, but many struggle with poor perceived physical appearance, damaged body image and problems with socialisation. The high importance placed on appearance for individuals in today's society also impacts upon achieving adjustment to an altered appearance. Considering this, cosmetic camouflage may be a valid intervention to give this population some reprieve from the continual need to manage societal and personal challenges and expectations.

Cosmetic camouflage, the skilled use of camouflaging make-up [27] can conceal visible scarring and improve overall social and psychological well-being [27,28]. Holme et al. found that quality of life as well as social and psychological well-being increased significantly for 56 adults with disfigurement (e.g., vitiligo and scarring) after attending a cosmetic camouflage clinic [8]. However, differing views about cosmetic camouflage exist in the literature. For example, Kent [29] argued that cosmetic camouflage could be seen as concealment and therefore a negative or avoidant coping mechanism. Nevertheless, when Kent [30] examined the effects of a skin camouflage service on well-being and appearance anxiety of 34 adult patients with skin conditions (mainly vitiligo and scars), the results indicated that those who found the cosmetic cream effective also experienced improved psychological well-being.

There are few paediatric studies investigating cosmetic camouflage. Tedeschi et al. in an Italian study found substantial improvements in quality of life for fifteen children aged 7–16 years with a range of skin conditions [31]. Our own work conducted in Australia, on camouflage for children with burn scarring found that children reported feeling happier, more confident and enjoyed social outings after using the cosmetic camouflage, Microskin™ [32]. Both of these studies

are small and clearly further research with larger samples and better methodology is necessary to improve our understanding of psychosocial well-being of children and adolescents with burn scarring and the use of cosmetic camouflage as an intervention. The following research questions were designed to add to the limited research in this area.

- To what degree does cosmetic camouflage, Microskin™ impact upon the perceptions of scar appearance to children and adolescents with burn scarring and their caregiver?
- What is the effect of applying a cosmetic camouflage, Microskin™ on overall psychosocial functioning of children and adolescents with burn scarring?

It was hypothesised the use of a cosmetic camouflage, as a therapeutic tool would improve quality of life, self-concept, perceptions of appearance and socialisation for children and adolescents with burn scarring.

2. Method

This current study was a multi-centred prospective randomised control trial with a wait-list design. Ethics approval was

obtained from each Health Research Ethics Committee (HREC) and relevant research governance department of every paediatric burn centre involved as well as The University of Queensland, Human Research Ethics Committee.

2.1. Participants

Between December 2009 and October 2010, children and adolescents were recruited from six paediatric burn centres; Royal Children's Hospital, Brisbane; The Children's Hospital at Westmead Sydney; The Children's and Women's Hospital, Adelaide; Royal Hobart Hospital, Hobart; Princess Margaret Hospital, Perth and Middlemore Hospital, Auckland, New Zealand. Inclusion criteria were: (1) Children and adolescents 8–16 years, (2) a burn past the acute stage of healing, with mature scarring present on a visible area of the body. Exclusion criteria were: (1) cognitive impairment preventing the use of outcome measures and/or intervention, (2) inadequate English language proficiency, (3) psychological difficulties or co-morbidity as the contemporaneous treatment of these problems may have confounded the findings. Sample size power calculations indicated a total 102 participants were required in each group to maintain Type II error at .20 (i.e. power at .80) and $\alpha < .05$ (i.e., maintaining Type I error at .05),

Table 1 – Baseline demographic characteristics.

	Intervention (n = 35)	Wait-list control (n = 28)	Total (n = 63)	p-Value
Age, years	12.23 (1.97)	13.31 (2.22)	12.72 (2.14)	0.04
Age at burn, years	5.77 (4.07)	4.96 (4.51)	5.41 (4.26)	0.46
Years since burn	6.46 (4.55)	8.39 (4.67)	7.31 (4.67)	0.1
Sex, female	24 (68.8%)	24 (82.8%)	48 (75%)	0.19
Culture				0.84
Caucasian Australian	23 (65.7%)	14 (50%)	37 (58.7%)	
Aboriginal	2 (5.7%)	3 (10.7%)	5 (7.9%)	
Samoan	2 (5.7%)	1 (3.6%)	3 (4.8%)	
Maori	1 (2.9%)	1 (3.6%)	2 (3.2%)	
Tongan	1 (2.9%)	1 (3.6%)	2 (3.2%)	
English		3 (10.7)	3 (4.8%)	
Other	6 (14.5%)	5 (18%)	11 (17.6%)	
TBSA %	23.53 (19.48)	21.19 (19.52)	22.52 (19.37)	0.65
Mode				0.46
Scald	16 (45.7%)	13 (46.4%)	29 (46%)	
Contact	1 (2.9%)	4 (14.3%)	5 (7.9%)	
Flame	16 (45.7%)	9 (32.1%)	25 (39.7%)	
Friction		2 (7.1%)	2 (3.2%)	
Chemical	1 (2.9%)		1 (1.6%)	
Thermal	1 (2.9%)		1 (1.6%)	
Location of scarring				0.23
Visible	24 (68.6%)	15 (53.6%)	39 (61.9%)	
Non-visible	11 (31.4%)	13 (46.4)	24 (38.1%)	
Study site				0.92
RCH, Brisbane	11 (31.4%)	10 (35.7%)	21 (33.3%)	
PMH, Perth	6 (17.1%)	4 (14.3%)	10 (15.9%)	
CYWH, Adelaide	7 (20%)	5 (17.9%)	12 (19%)	
Westmead, Sydney	5 (14.3%)	4 (14.3%)	9 (14.3%)	
RHH, Hobart	1 (2.9%)	1 (3.6%)	2 (3.2%)	
MH, Auckland	5 (14.3%)	4 (14.3%)	9 (14.3%)	
Microskin™ application				0.18
Airbrush	31 (88.6%)	21 (75%)	52 (82.5%)	
Stipple	4 (11.4%)	7 (25%)	11 (17.5%)	
Caregiver participating, mother	28 (80%)	20 (71.4%)	48 (76.2%)	0.5

p-Value: difference between the intervention and wait-list control groups (t-tests for continuous variables, chi-square for nominal variable).

Table 2 – PedsQL descriptives for both intervention and wait-list control for Time 1 (T₁) and Time 2 (T₂).

	α	Wait-list control		Intervention	
		T ₁	T ₂	T ₁	T ₂
		M (SD)	M (SD)	M (SD)	M (SD)
PedsQL4.0					
Child self-report					
Physical health	.83	86.16 (15.20)	87.79 (13.36)	85.36 (15.0)	90.18 (9.34)
Psychosocial health	.90	73.48 (16.92)	75.81 (17.24)	77.32 (15.71)	80.03 (11.87)
Emotional functioning	.83	75.36 (19.86)	73.84 (23.87)	77.71 (19.52)	79.04 (15.16)
Social functioning	.84	78.33 (21.66)	85.37 (16.79)	82.21 (16.53)	85.17 (13.95)
School functioning	.78	66.79 (22.82)	68.19 (20.41)	72.00 (16.94)	75.50 (13.98)
Total score	.93	77.97 (15.66)	79.93 (15.16)	80.12 (14.53)	83.57 (10.03)
Perceived physical appearance	.83	50.00 (28.7)	54.52 (25.48)	60.24 (31.77)	69.50 (23.48)
Parent report					
Physical health	.86	75.50 (26.45)	80.48 (21.35)	80.80 (18.52)	86.49 (12.37)
Psychosocial health	.85	67.71 (17.55)	72.1 (14.02)	70.16 (13.76)	74.68 (10.38)
Emotional functioning	.80	64.72 (22.92)	71.38 (19.71)	66.21 (17.29)	69.32 (11.89)
Social functioning	.78	70.49 (22.47)	78.69 (16.94)	75.29 (18.98)	81.82 (14.31)
School functioning	.84	66.39 (24.4)	67.07 (21.59)	65.00 (21.76)	69.46 (12.54)
Total score	.91	70.22 (19.45)	75.17 (16.51)	73.06 (17.97)	78.04 (10.19)
Perceived physical appearance	.79	49.11 (25.79)	53.12 (23.55)	63.10 (21.98)	69.34 (16.34)

with a medium effect size estimated for difference between control group and intervention group.

2.2. Outcome measures

2.2.1. The Paediatric Quality of Life Inventory™ 4.0 (PedsQL) [33]

The PedsQL measures health-related quality of life in children and adolescents aged 2–18 years and has been validated in children after trauma [34]. It consists of 23 items covering four dimensions of functioning: (1) physical, (2) emotional, (3) social and (4) school. This measure has a parent proxy format as well as child self-report. Strong internal consistency was reached for the present sample for all subscales and summary scores for both child and parent report, Cronbach alpha $\geq .78$ (see Table 2).

As this study has a particular focus on the psychosocial impact of burn scarring, the perceived physical appearance (PPA) sub-scale taken from the PedsQL Cancer Module [35] was included, with the authors' permission. The PPA sub-scale has three items specifically related to scarring. Varni et al. also found the parent report perceived physical appearance sub-scale to have strong internal consistency (Cronbach alpha = .81) with good reported validity [35,36]. Perceived physical appearance for the present sample also has strong internal consistency for both parent and child report, Cronbach alpha $\geq .79$ (see Table 2). This subscale was included for descriptive, exploratory purposes only.

2.2.2. The Strengths and Difficulties Questionnaire (SDQ) [37] The SDQ is a brief 25-item measure of psychological adjustment and psychopathology for 3–16 year olds and can be

Table 3 – SDQ descriptives for both intervention and wait-list control for Time 1 (T₁) and Time 2 (T₂).

	α	Wait-list control		Intervention	
		T ₁	T ₂	T ₁	T ₂
		M (SD)	M (SD)	M (SD)	M (SD)
SDQ					
Child self report					
Emotional symptoms	.73	3.36 (2.16)	3.3 (2.3)	2.80 (2.51)	2.11 (1.59)
Conduct problems	.63	2.32 (1.63)	2.18 (2.11)	2.54 (1.93)	2.32 (1.47)
Hyperactivity-inattention	.60	4.57 (2)	4.4 (2.48)	4.29 (2.15)	4.06 (1.70)
Peer problems	.62	2.32 (1.87)	1.92 (1.96)	2.40 (2.08)	1.76 (1.32)
Pro-social behaviour	.68	7.79 (1.79)	7.96 (1.80)	7.60 (2.00)	7.41 (1.66)
Total difficulties	.80	12.57 (5.2)	11.79 (6.51)	12.03 (6.31)	10.24 (4.13)
Parent report					
Emotional symptoms	.44	2.75 (1.67)	2.52 (2.01)	2.89 (1.78)	2.62 (1.66)
Conduct problems	.67	2.14 (1.88)	1.71 (2.2)	2.20 (2.04)	1.96 (1.52)
Hyperactivity-inattention	.72	4.00 (2.61)	3.2 (1.8)	4.20 (2.06)	4.56 (1.84)
Peer problems	.67	2.00 (1.81)	1.7 (2)	2.74 (1.98)	2.09 (1.56)
Pro-social behaviour	.67	8.04 (2.08)	7.74 (1.86)	7.54 (1.95)	7.46 (1.82)
Total difficulties	.74	10.89 (5.66)	9.15 (6.16)	12.03 (5.37)	11.23 (4.86)

Table 4 – P-H SCS descriptives for both intervention and wait-list control for Time 1 (T₁) and Time 2 (T₂).

	α	Wait-list control		Intervention	
		T ₁	T ₂	T ₁	T ₂
		M (SD)	M (SD)	M (SD)	M (SD)
P-H SCS (child self report only)					
Behavioural adjustment	.81	49.41 (10.91)	50.34 (10.48)	50.42 (9.64)	50.17 (7.89)
Intellectual and school status	.72	50.11 (11.48)	50.93 (9.12)	50.35 (8.83)	49.68 (9.09)
Physical appearance and attributes	.72	49.62 (10.62)	50.66 (8.44)	50.43 (9.90)	49.79 (9.49)
Freedom from anxiety	.85	48.43 (9.21)	48.58 (9.15)	51.99 (10.12)	51.43 (9.16)
Popularity	.72	50.71 (9.01)	51.2 (7.9)	49.44 (11.08)	49.86 (9.18)
Happiness and satisfaction	.68	49.55 (10.44)	49.33 (9.08)	50.56 (9.77)	50.88 (9.25)
Total score	.90	49.43 (10.51)	50.28 (8.88)	50.82 (9.80)	50.19 (9.35)

completed by children and adolescents, parents and/or teachers [37]. The SDQ is sensitive to change over a short period of time and is a widely used instrument in research related to mental health [37,38]. Participants and one caregiver were given the questionnaire to complete independently.

There are five subscales: (1) emotional symptoms, (2) conduct problems, (3) hyperactivity-inattention, (4) peer problems and (5) pro-social behaviour. The SDQ has satisfactory reliability and validity [37]. Strong internal consistencies were also reached for the total score for child and parent report for the present sample, Cronbach alpha $\geq .74$ (see Table 3). Some subscales of both child and parent report fell short of reaching satisfactory reliability (e.g., Cronbach alpha = .44 for parent report of emotional symptoms (see Table 3)). This measure was used for the entire age sample in this study (8–17 years) as Mellor [39] and Goodman [37] have found that children as young as seven years can report as reliably as older children. The SDQ parent report has been examined in terms of the psychometric properties within an Australian paediatric population and has demonstrated positive utility as a measure of psychopathology in young Australian children [40].

2.2.3. Piers-Harris Self-Concept Scale Version 2 (P-H SCS) [41]
P-H SCS is a 60-item self-report questionnaire with dichotomous “yes/no” response options to items that assess global self-concept in children and adolescents. There are six subscales: (1) physical appearance and attributes, (2) freedom from anxiety, (3) intellectual and school status, (4) behavioural adjustment, (5) happiness and satisfaction and (6) popularity. These subscales can be analysed separately and as an overall score.

The scale is a frequently used clinical measure, recommended over other measures of self-concept [41]. It has also been found to be sensitive to change over a short time period and to have consistent psychometric properties [42]. The scale has excellent internal consistency, test-retest reliability as well as strong content, construct, and criterion validity [41]. The present study found good internal consistencies for the total score and all subscales (Cronbach alpha $\geq .72$) except happiness and satisfaction which fell short (Cronbach alpha = .68). See Table 4.

2.2.4. Family Assessment Device (FAD) [43]

The McMaster Family Assessment Device – General Functioning Scale is a 12-item scale derived from the longer 60-item

Family Assessment Device and provides a global assessment of family functioning. The FAD-GF consists of six items describing healthy functioning and six describing unhealthy family functioning. The FAD-GF is easy for participants to interpret and complete [44]. It has sound reliability and validity [45]. Higher scores represent more problematic overall family functioning [44]. Strong internal consistency was found for the child report in the present study (Cronbach alpha = .97) however the parent report fell short of acceptable standards (Cronbach alpha = .52). See Table 5.

2.2.5. Microskin™ questionnaire (MSQ)

This questionnaire was developed by Martin et al. [32]. It consists of 18-items with a variety of Likert scale questions, dichotomous yes/no questions and open-ended questions and was developed as a measure of participants' impressions regarding the cosmetic camouflage product on aspects such as application and regularity of use. The Microskin™ questionnaire contains descriptive information interpreted on an item-by-item basis.

2.2.6. Intervention: Microskin™

Microskin™ is cosmetic camouflage, liquidised simulated second skin that binds to the epidermis of the skin. Via the use of digital photography and a computer colour-matching program the individual's unique skin colour is formulated. Microskin™ can last on the skin for several days and is water and sun resistant. It is applied using a sponge or roller for smaller areas and an air brush with compressor for larger areas and is removed with an alcohol-based serum. Microskin™ is designed to colour correct an affected area, not change the texture of the skin (Fig. 1).

Table 5 – FAD descriptives for both intervention and wait-list control for Time 1 (T₁) and Time 2 (T₂).

	α	Wait-list control		Intervention	
		T ₁	T ₂	T ₁	T ₂
		M (SD)	M (SD)	M (SD)	M (SD)
FAD					
Child self report					
Total score	.97	1.75 (0.51)	1.68 (0.55)	2.03 (0.50)	1.83 (0.54)
Parent report					
Total score	.52	1.36 (2.61)	1.62 (0.47)	1.50 (1.37)	1.75 (0.33)

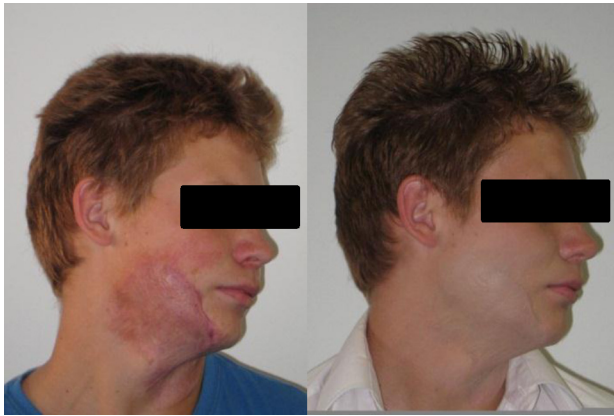


Fig. 1 – Before and after Microskin™. A patient with facial burn scarring before and after application of Microskin™.

2.3. Procedure

The trial (see Fig. 2: Consort Diagram) was explained to all participants on presentation to follow-up outpatient appointments or over the phone. Written consent was obtained and recruitment procedures completed by a nurse, social worker or psychologist in each burn outpatient clinic. For each centre, randomisation into either the intervention or wait-list control group was achieved using computer-generated random numbers and an independent staff member from Royal Children's Hospital, Brisbane. The assignments were placed in sealed and consecutively numbered opaque envelopes by the staff member, and opened by the contact person at each site when consent was obtained. The random numbers list was confidential and unknown to the primary researcher.

Baseline (Time 1) data (PedsQL 4.0, SDQ, P-H SCS, FAD) for both groups (Intervention and Wait-list Control) were gathered with demographic information two weeks prior to the intervention group receiving the cosmetic camouflage intervention and the wait-list control starting the waiting period.

The intervention the intervention group attended a 1.5 day Microskin™ training program at each study site's burn centre or at the Microskin™ International training rooms (Brisbane participants). After training participants were provided with the Microskin™ equipment necessary to apply the product at home and begin using the product. After 8 weeks of product use, the Intervention group repeated questionnaire completion (Time 2) with the addition of the Microskin™ questionnaire (MSQ). Questionnaires were mailed to participants in the intervention group two weeks prior to their return to hospital sites to complete a booster training session.

The wait-list group waited for 8 weeks, repeated questionnaires (Time 2), then completed the Microskin™ training and began using the product at home. Similar to the intervention group, the wait-list group repeated questionnaires (Time 3) with the addition of the Microskin™ questionnaire (MSQ) after 8 weeks of use. Both intervention and wait-list control groups repeated questionnaires (including the MSQ) via mail-out, at four months and six month following initial Microskin™ use. In total, the intervention

covered 26 weeks of product use. Only Time 1 and Time 2 results are presented in this paper.

Questionnaire completion took approximately 15–30 min at each time point, child and caregiver completing measures separately. Caregivers completed parent versions of all measures except the P-H SCS as no parent report exists.

3. Results

3.1. Participant characteristics

A total sample of 63 children and adolescents (8 and 16 years), and their primary caregiver, were recruited from six paediatric burn centres in Australia and New Zealand (see Fig. 2: Consort Diagram). Thirty-five children were randomly allocated to the intervention group with 28 in the wait-list control group. These numbers reduced to 24 and 17 respectively at Time 2. Full baseline descriptive information for the sample is presented in Table 1. There were no significant differences between groups at baseline for any sample characteristics (age at burn, time since burn, gender, culture, TBSA, mode, location of scarring, study site, Microskin™ application, caregiver) except age (see Table 1).

3.2. Data analysis

The focal design of the study was 2 (Group: intervention vs. wait-list) $\times$ 2 (Time: 1 vs. 2) with group as a between-subjects factor and time as a within-subjects factor. Time 1 was defined as baseline for both groups. Time 2 (8 weeks following baseline) was defined as post-intervention for the intervention group and re-test for the wait-list group. Mixed model 2 $\times$ 2 ANOVAs with t-tests as necessary follow-ups were used to analyse results. Further analyses investigated the impact of gender, age and visibility of scars on responses for the intervention group only. Due to a relatively high level of attrition and missing data an intent-to-treat analysis was employed. Data was analysed using SPSS software v20. Due to the number of analyses, only significant findings will be reported as well as non-significant findings of important theoretical or applied note.

3.2.1. PedsQL

The PedsQL results are taken from both child self-report and parent report. Results at Time 1 and Time 2 are outlined in Table 2.

3.2.1.1. Child report. There were main effects for time for social functioning and perceived physical appearance as well as physical health nearing significance at $p = .06$. Across time, participants showed improved social functioning (T_1 : $M = 80.52$, $SD = 18.87$; T_2 : $M = 85.29$, $SD = 15.19$) and improved perceived physical appearance (T_1 : $M = 55.69$, $SD = 30.63$; T_2 : $M = 62.72$, $SD = 25.35$) (Table 6). A main effect for group was also found for perceived physical appearance (intervention: $M = 64.87$, $SD = 24.08$; wait-list: $M = 52.21$, $SD = 24.61$) (see Table 6). There were no significant interactions between group and time across any subscale or total score for the PedsQL child report. However, in line with the hypotheses,

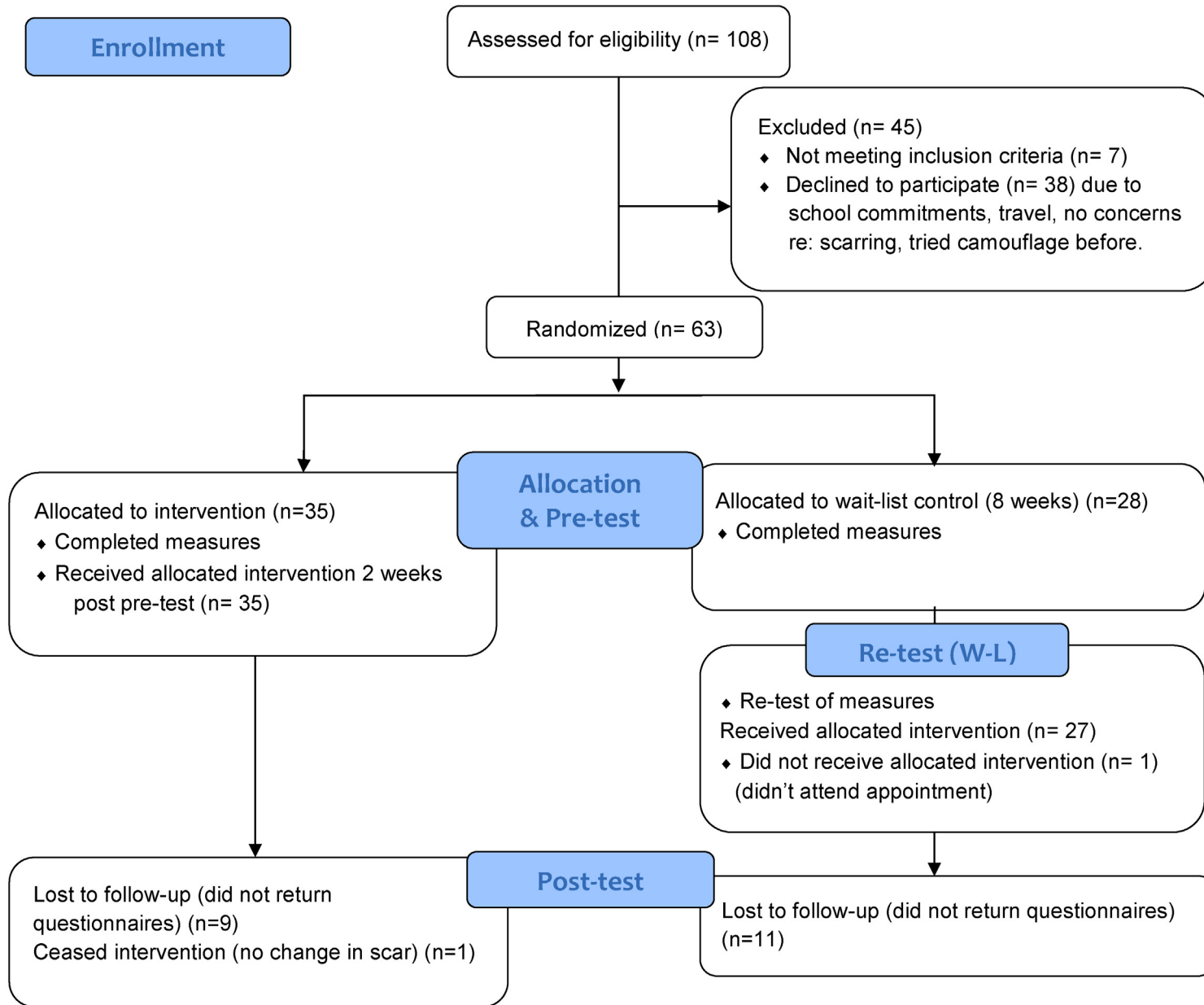


Fig. 2 – Study Consort Diagram.

Table 6 – PedsQL group and time effects and main interactions between group and time.

Outcome	Effect		
	Group	Time	Group × time
PedsQL4.0			
Child self report			
Physical health	$F(1, 61) = 0.08, p = 0.79$	$F(1, 61) = 3.48, p = 0.06$	$F(1,61) = 0.87, p = 0.36$
Psychosocial functioning	$F(1, 61) = 1.3, p = 0.26$	$F(1, 61) = 2.08, p = 0.15$	$F(1, 61) = 0.01, p = 0.93$
Emotional functioning	$F(1, 61) = 0.74, p = 0.39$	$F(1, 61) = 0.01, p = 0.94$	$F(1,61) = 0.57, p = 0.45$
Social functioning	$F(1, 60) = 0.25, p = 0.62$	$F(1, 60) = 5.35, p = 0.02^*$	$F(1, 60) = 0.82, p = 0.37$
School functioning	$F(1, 61) = 2.21, p = 0.14$	$F(1, 61) = 1.32, p = 0.26$	$F(1, 61) = 0.22, p = 0.64$
Total score	$F(1, 61) = 0.85, p = 0.36$	$F(1, 61) = 2.72, p = 0.1$	$F(1, 61) = 0.2, p = 0.66$
Perceived physical appearance	$F(1, 61) = 4.03, p = 0.05^*$	$F(1, 61) = 4.66, p = 0.04^*$	$F(1, 61) = 0.47, p = 0.5$
Parent report			
Physical health	$F(1, 60) = 1.99, p = 0.16$	$F(1, 60) = 3.01, p = 0.09$	$F(1, 60) = 0.35, p = 0.85$
Psychosocial functioning	$F(1, 61) = 0.65, p = 0.42$	$F(1, 61) = 6.57, p = 0.01^{**}$	$F(1, 61) = 0.001, p = 0.98$
Emotional functioning	$F(1, 60) = 0.01, p = 0.94$	$F(1, 60) = 4.92, p = 0.03^*$	$F(1, 60) = 0.67, p = 0.42$
Social functioning	$F(1, 60) = 1.18, p = 0.28$	$F(1, 60) = 7.5, p = 0.01^{**}$	$F(1, 60) = 0.05, p = 0.83$
School functioning	$F(1, 60) = 0.01, p = 0.91$	$F(1, 60) = 0.97, p = 0.33$	$F(1, 60) = 0.57, p = 0.46$
Total score	$F(1, 60) = 0.82, p = 0.37$	$F(1, 60) = 5.01, p = 0.03^*$	$F(1, 60) = 0.004, p = 0.95$
Perceived physical appearance	$F(1, 61) = 9.23, p = 0.003^{**}$	$F(1, 61) = 4.08, p = 0.05^*$	$F(1, 61) = 0.14, p = 0.72$
* Equal to or less than 0.05.			
** Equal to or less than 0.01.			

follow-up t-tests for time effects were completed for both intervention and wait-list groups separately. For the intervention group there were significant time effects for physical health ($p = .05$) and neared significance for school functioning ($p = .053$) and perceived physical appearance ($p = .06$) suggesting participants' quality of life within these three subscales improved over time whilst using the camouflage. A time effect (T_1 : $M = 78.28$, $SD = 21.14$; T_2 : $M = 85.21$, $SD = 16.77$, $p = .05$) was revealed for the wait-list group on the social functioning scale suggesting that the wait-list group felt their social functioning improved over the time they were waiting to receive the intervention.

3.2.1.2. Parent report. There were main effects of time for emotional functioning, social functioning, overall psychosocial functioning and total score with p 's $\leq .05$, indicating improved functioning at Time 2 over Time 1 (see Table 6) for the intervention group. For perceived physical appearance, there were significant main effects for both time (T_1 : $M = 56.88$, $SD = 24.57$; T_2 : $M = 62.27$, $SD = 21.42$, $p = .05$) showing that perceived physical appearance improved over time and group (intervention: $M = 66.22$, $SD = 15.49$; wait-list control: $M = 51.04$, $SD = 23.02$, $p = .003$) showing that the wait-list group had lower scores across time for perceived physical appearance than the intervention group (see Table 6). There were no significant interactions between group and time across any sub-scale or total score for the PedsQL. In line with hypotheses, follow-up t-tests were completed separately for each of the intervention and wait-list groups. For the intervention group, there was a significant time effect for school functioning (T_1 : $M = 65$, $SD = 21.76$; T_2 : $M = 75.5$, $SD = 13.99$, $p = .012$) while social functioning neared significance (T_1 : $M = 75.29$, $SD = 18.98$; T_2 : $M = 81.82$, $SD = 14.31$, $p = .06$) showing that across time the participants school and social functioning improved over the period of Microskin™ use. A time effect (T_1 : $M = 64.91$, $SD = 22.35$; T_2 : $M = 71.39$, $SD = 19.71$, $p = .03$) was also revealed for the wait-list group for emotional functioning

suggesting that the parents of the participants in the wait-list group reported that their children's emotional functioning improved whilst waiting for and expecting the intervention.

To further explore the efficacy of the Microskin™ intervention, analyses for age, gender and visibility of scarring were conducted. Based on the literature it was hypothesised that adolescents (≥ 13 years of age) with burn scarring will have more psychosocial difficulties than children (≤ 12 years of age) with burn scarring [18], that females will report more difficulties with appearance and body image than males [26]; that young people with visible scarring will struggle with social acceptance and self-perception more than young people with non-visible scars (i.e. concealed under clothing) [21] and finally that the Microskin™ intervention will have a positive impact on these participant groups[32]. To examine these hypotheses, 2 (time) $\times$ 2 (age/gender/visibility) ANOVAs were completed for each PedsQL subscale and total scores, for the intervention group only. The following discussion will only report on the significant findings relevant to age, gender, and visibility, respectively.

3.2.1.3. Age.

3.2.1.3.1. Child report. For physical health there was a significant main effect for age, $F(1, 33) = 4.16$, $p = .049$. In line with hypotheses, adolescents ($M = 84.01$, $SD = 12.21$) reported significant improvements in physical health over time, $F(1, 33) = 4.25$, $p = .047$ but the younger children ($M = 90.93$, $SD = 7.67$) did not, $F(1, 33) = 0.85$, $p = .363$.

There was a main effect of age for emotional functioning, $F(1, 33) = 6.60$, $p = .015$ with younger children ($M = 84.1$, $SD = 11.38$) reporting better emotional functioning than adolescents ($M = 71.98$, $SD = 16.43$); psychosocial health, $F(1, 33) = 5.31$, $p = .028$ again adolescents ($M = 73.996$, $SD = 13.66$) reporting lower psychosocial health than younger children ($M = 82.62$, $SD = 8.23$); and total score, $F(1, 33) = 5.86$, $p = .021$ adolescents ($M = 77.48$, $SD = 12.31$) reporting lower overall quality of life than younger children ($M = 85.51$, $SD = 7.01$).

There was also a main effect for age, $F(1, 33) = 5.04$, $p = .032$ adolescents ($M = 55.45$, $SD = 27.69$) reporting significantly poorer perceived physical appearance than younger children ($M = 72.8$, $SD = 17.64$), suggesting that adolescence is a difficult period of development for teenagers with burn scarring.

3.2.1.3.2. Parent report. For the intervention group, a main effect for age was found, $F(1, 33) = 4.73$, $p = .037$ for school functioning indicating that the two age groups reported differently across time with parents reporting adolescents showed significant improvement (≤ 12 years: $M = 71.73$, $SD = 13.36$; ≥ 13 years: $M = 61.88$, $SD = 13.30$). In line with hypotheses, parents of adolescents (T_1 : $M = 72.81$, $SD = 20.65$; T_2 : $M = 84.68$, $SD = 12.40$) felt their child's social functioning improved after the intervention, Wilks Lambda = .85, $F(1, 33) = 5.89$, $p = .021$ whereas parents of younger children (T_1 : $M = 77.37$, $SD = 17.75$; T_2 : $M = 79.41$, $SD = 15.66$) did not, $F < 1$.

3.2.1.4. Gender.

3.2.1.4.1. Child report. Females showed significant improvements in physical health across time whilst using Microskin™, Wilks Lambda = .81, $F(1, 33) = 7.77$, $p = .009$ but males did not, $F < 1$. Similarly, for perceived physical appearance females showed significant improvements after the 8 week use of Microskin™, Wilks Lambda = .87, $F(1, 33) = 5.06$, $p = .031$ and males did not, $F < 1$.

3.2.1.5. Visibility. Visibility was defined as 'visibility of scarring all year round including the winter months versus scarring concealed under clothing'. Visibility thus included scarring on the face, head, neck, hands and lower arms.

3.2.1.6. Child report. For the intervention group, no main effects for visibility were found for physical health. However, further analysis revealed that the children with 'visible scars' reported significant improvements in physical health following the Microskin™ intervention, Wilks Lambda = .86, $F(1, 33) = 5.18$, $p = .029$ compared to children with scarring concealed due to clothing, $F < 1$. In line with hypotheses, children with 'visible scars' reported improvements over time for school functioning, Wilks Lambda = .89, $F(1, 33) = 4.11$, $p = .05$ compared to children with non-visible scarring, $F < 1$.

3.2.1.7. Parent report. For social functioning a time $\times$ visibility interaction was revealed, Wilks Lambda = .82, $F(1, 33) = 7.25$, $p = .011$. Simple effects analysis showed that caregivers of children with visible scarring reported significant improvements in their child's social functioning, Wilks Lambda = .76, $F(1, 33) = 10.63$, $p = .003$ whilst using Microskin™ whereas parents of those with non-visible scarring did not, Wilks Lambda = .97, $F(1, 33) = 1.09$, $p = .304$.

Similar to social functioning, a time $\times$ visibility interaction was found for school functioning, Wilks Lambda = .795, $F(1, 33) = 8.53$, $p = .006$. Caregivers' of children with visible scarring felt their children had significantly improved school functioning, Wilks Lambda = .81, $F(1, 33) = 7.55$, $p = .01$ after using Microskin™ but the parents of children with non-visible scarring did not, Wilks Lambda = .92, $F(1, 33) = 2.78$, $p = .105$.

For psychosocial health, an interaction between time and visibility was also found, Wilks Lambda = .82, $F(1, 33) = 7.25$, $p = .011$ with caregivers' reporting that the psychosocial health

of their child with visible scarring had improved post-intervention, Wilks Lambda = .76, $F(1.33) = 10.28$, $p = .003$ whereas children with non-visible scarring had not, Wilks Lambda = .97, $F(1, 33) = 1.17$, $p = .287$.

Finally the total score also showed a time $\times$ visibility interaction, Wilks Lambda = .88, $F(1, 33) = 4.54$, $p = .041$ with caregivers' of children with visible scarring reporting their child's overall quality of life had improved after using Microskin™, Wilks Lambda = .81, $F(1, 33) = 7.63$, $p = .009$ compared to those with non-visible scarring, $F < 1$.

No significant effects involving visibility were found for perceived physical appearance. However, in line with hypotheses, further analyses revealed that caregivers' of children with visible scarring did feel that their child's perceived physical appearance had improved after using camouflage, Wilks Lambda = .89, $F(1, 33) = 4.08$, $p = .052$ whereas for children with non-visible scarring it had not, $F < 1$. Overall, on parental report it appears that quality of life, perceived physical appearance and social and school functioning all improved post-intervention for participants with visible scarring.

3.2.2. SDQ

SDQ results are taken from both child self-report and parent report. The descriptive results at Time 1 and Time 2 are outlined in Table 3.

3.2.2.1. Child report. There were time main effects for peer problems and the total SDQ score (see Table 7). Across time, participants showed decreased peer problems (T_1 : $M = 2.37$, $SD = 1.97$; T_2 : $M = 1.83$, $SD = 1.64$) and total SDQ score (T_1 : $M = 12.27$, $SD = 5.80$; T_2 : $M = 10.93$, $SD = 5.40$). In line with hypotheses, follow-up t-tests for time effects in the intervention group showed significant improvement for emotional symptoms (T_1 : $M = 2.80$, $SD = 2.51$; T_2 : $M = 2.11$, $SD = 1.59$, $p = .045$) and peer problems ($p = .017$) as well as the total SDQ score ($p = .04$) indicating that psychopathology improved over time whilst using Microskin™. There were no significant interactions between group and time across any of the subscales or total score for the SDQ child report.

3.2.2.2. Parent report. An interaction between group and time for the hyperactivity-inattention subscale was revealed, $p = .026$. Simple effects analyses revealed a significant group effect at Time 2, with parents of the wait-list group reporting less hyperactivity-inattention than the intervention group, $p = .006$, while no such difference was evident at Time 1, $p = 0.735$. A time effect was evident for the wait-list group with hyperactivity-inattention significantly less at Time 2 than Time 1, $p = .039$, but not for the intervention group, $p = 0.285$.

There were main effects for time for peer problems and total score (see Table 7). Across time, parents reported their child's problems with peers improved (T_1 : $M = 2.41$, $SD = 1.92$; T_2 : $M = 1.92$, $SD = 1.78$, $p = .04$) and in line hypotheses, follow-up t-tests supported this (T_1 : $M = 2.74$, $SD = 1.98$; T_2 : $M = 2.09$, $SD = 1.56$, $p = .014$). In addition, parent's report suggested an overall improvement in psychopathology (T_1 : $M = 11.52$, $SD = 5.48$; T_2 : $M = 10.31$, $SD = 5.58$, $p = .047$).

Follow-up analyses investigating age, gender and visibility effects for the SDQ were also conducted.

Table 7 – SDQ group and time effects and main interactions between group and time.

Outcome	Effect		
	Group	Time	Group × time
SDQ			
Child self report			
Emotional symptoms	$F(1, 61) = 3.06, p = 0.09$	$F(1, 61) = 2.61, p = 0.11$	$F(1, 61) = 0.168, p = 0.2$
Conduct problems	$F(1, 61) = 0.21, p = 0.65$	$F(1, 61) = 0.57, p = 0.45$	$F(1, 61) = 0.03, p = 0.86$
Hyperactivity-inattention	$F(1, 61) = 0.45, p = 0.51$	$F(1, 61) = 0.68, p = 0.41$	$F(1, 61) = 0.02, p = 0.9$
Peer problems	$F(1, 61) = 0.01, p = 0.91$	$F(1, 61) = 4.52, p = 0.038^*$	$F(1, 61) = 0.26, p = 0.61$
Pro-social behaviour	$F(1, 61) = 0.83, p = 0.37$	$F(1, 61) = 0.002, p = 0.97$	$F(1, 61) = 0.57, p = 0.45$
Total difficulties	$F(1, 61) = 0.67, p = 0.42$	$F(1, 61) = 4.22, p = 0.044^*$	$F(1, 61) = 0.65, p = 0.42$
Parent report			
Emotional symptoms	$F(1, 61) = 0.09, p = 0.77$	$F(1, 61) = 1.82, p = 0.18$	$F(1, 61) = 0.004, p = 0.95$
Conduct problems	$F(1, 61) = 0.12, p = 0.73$	$F(1, 61) = 1.56, p = 0.22$	$F(1, 61) = 0.11, p = 0.74$
Hyperactivity-inattention	$F(1, 61) = 2.69, p = 0.11$	$F(1, 61) = 0.72, p = 0.4$	$F(1, 61) = 5.24, p = 0.026^*$
Peer problems	$F(1, 61) = 1.9, p = 0.17$	$F(1, 61) = 4.42, p = 0.04^*$	$F(1, 61) = 0.62, p = 0.43$
Pro-social behaviour	$F(1, 61) = 0.82, p = 0.37$	$F(1, 61) = 0.61, p = 0.44$	$F(1, 61) = 0.2, p = 0.66$
Total difficulties	$F(1, 61) = 1.63, p = 0.21$	$F(1, 61) = 4.1, p = 0.05^*$	$F(1, 61) = 0.56, p = 0.46$

* Equal to or less than 0.05.

3.2.2.3. Age.

3.2.2.3.1. *Child report.* The younger group reported fewer problems with peers at Time 2 than at Time 1 (T_1 : $M = 2.53$, $SD = 2.57$; T_2 : $M = 1.7$, $SD = 1.14$), Wilks Lambda = .83, $F(1, 33) = 6.58$, $p = .015$. However the older group reported no significant peer problem differences across time, (T_1 : $M = 2.25$, $SD = 1.34$, T_2 : $M = 1.89$, $SD = 1.53$), $F < 1$.

3.2.2.3.2. *Parent report.* Although no time × age interaction was found for peer problems, Wilks Lambda = .97, $F(1, 33) = 1.095$, $p = .303$, further analysis revealed that caregivers of the older group (T_1 : $M = 2.87$, $SD = 2.19$; T_2 : $M = 1.93$, $SD = 1.65$) reported significantly fewer peer problems whilst using the intervention, Wilks Lambda = .84, $F(1, 33) = 6.41$, $p = .016$ than the caregivers of the younger group (T_1 : $M = 2.63$, $SD = 1.83$; T_2 : $M = 2.22$, $SD = 1.51$).

3.2.2.4. Gender.

3.2.2.4.1. *Child report.* A gender main effect was reported by the intervention group for the SDQ hyperactivity-inattention subscale, $F(1, 33) = 6.79$, $p = .014$. Within this, males ($M = 5.18$, $SD = 1.44$) reported significantly higher hyperactivity-inattention scores than did females ($M = 3.71$, $SD = 1.60$).

With respect to SDQ peer problems, females (T_1 : $M = 2.13$, $SD = 1.73$; T_2 : $M = 1.42$, $SD = 1.0$) reported fewer problems after the Microskin™ intervention, Wilks Lambda = .87, $F(1, 33) = 4.95$, $p = .033$ than did males (T_1 : $M = 3.0$, $SD = 2.68$; T_2 : $M = 2.47$, $SD = 1.66$), Wilks Lambda = .96, $F(1, 33) = 1.31$, $p = .26$.

For the SDQ total score for the intervention group a gender male effect was significant, $F(1, 33) = 4.12$, $p = .051$. Females ($M = 10.08$, $SD = 4.73$) reported significantly fewer psychological adjustment and psychopathology difficulties than did males ($M = 13.42$, $SD = 3.99$).

3.2.2.4.2. *Parent report.* There were no significant parent reported differences on the SDQ for any gender related main or interaction effects.

3.2.2.5. Visibility.

3.2.2.5.1. *Child report.* Participants with non-visible scarring (T_1 : $M = 3.27$, $SD = 2.69$; T_2 : $M = 1.92$, $SD = 1.96$) reported

significantly reduced emotional symptoms throughout the use of the intervention, Wilks Lambda = .86, $F(1, 33) = 5.30$, $p = .028$ in contrast to participants with visible scarring (T_1 : $M = 2.58$, $SD = 2.45$; T_2 : $M = 2.19$, $SD = 1.43$), Wilks Lambda = .97, $F(1, 33) = 0.98$, $p = .329$.

For peer problems there was a significant time × visibility interaction, Wilks Lambda = .77, $F(1, 33) = 9.86$, $p = .004$. Simple effects analysis revealed that participants with non-visible scarring (T_1 : $M = 3.18$, $SD = 1.78$; T_2 : $M = 1.47$, $SD = .78$) reported fewer peer problems after the Microskin™ intervention, Wilks Lambda = .65, $F(1, 33) = 17.51$, $p = .000$ than did participants with visible scarring (T_1 : $M = 2.04$, $SD = 2.14$; T_2 : $M = 1.88$, $SD = 1.5$), Wilks Lambda = .99, $F(1, 33) = .34$, $p = .57$.

Children with non-visible scarring (T_1 : $M = 14$, $SD = 6.42$; T_2 : $M = 10.09$, $SD = 4.51$) reported improved overall psychopathology (total SDQ score) following the intervention, Wilks Lambda = .82, $F(1, 33) = 7.26$, $p = .011$. Strangely, participants with visible scarring did not (T_1 : $M = 11.13$, $SD = 6.18$; T_2 : $M = 10.30$, $SD = 4.04$) did not, Wilks Lambda = .98, $F(1, 33) = .70$, $p = .41$.

3.2.2.5.2. *Parent report.* In line with hypotheses but contrary to the young people, parents of children with visible scarring (T_1 : $M = 3.12$, $SD = 2.01$; T_2 : $M = 2.25$, $SD = 1.65$) reported their child had fewer peer problems following Microskin™, Wilks Lambda = .796, $F(1, 33) = 8.45$, $p = .006$ but parents of participants with non-visible scarring (T_1 : $M = 1.91$, $SD = 1.70$; T_2 : $M = 1.74$, $SD = 1.35$) did not, $F < 1$.

3.2.3. P-H SCS (child self-report only)

No significant interactions were found for this scale on any sub-scales or the total score suggesting Microskin™ had no measurable impact on self-concept (see Table 8). Follow-up paired sample t-tests were also unable to demonstrate significant results.

3.2.4. FAD

No significant interaction was found between group and time for either child self-report or parent report on the FAD (Table 9). However both time and group neared significance at $p = .063$.

Table 8 – P-H SCS group and time effects and main interactions between group and time.

Outcome	Effect		
	Group	Time	Group × time
P-H SCS (child report only)			
Behavioural adjustment	$F(1, 61) = 0.04, p = 0.85$	$F(1, 61) = 0.11, p = 0.75$	$F(1, 61) = 0.34, p = 0.56$
Intellectual and school status	$F(1, 61) = 0.05, p = 0.83$	$F(1, 61) = 0.004, p = 0.95$	$F(1, 61) = 0.63, p = 0.43$
Physical appearance and attributes	$F(1, 61) = 0, p = 0.99$	$F(1, 61) = 0.06, p = 0.82$	$F(1, 61) = 0.87, p = 0.36$
Freedom from anxiety	$F(1, 61) = 2.05, p = 0.16$	$F(1, 61) = 0.05, p = 0.83$	$F(1, 61) = 0.17, p = 0.68$
Popularity	$F(1, 61) = 0.37, p = 0.54$	$F(1, 61) = 0.18, p = 0.67$	$F(1, 61) = 0.002, p = 0.97$
Happiness and satisfaction	$F(1, 63) = 0.39, p = 0.53$	$F(1, 61) = 0.004, p = 0.95$	$F(1, 61) = 0.07, p = 0.79$
Total score	$F(1, 63) = 0.08, p = 0.78$	$F(1, 61) = 0.02, p = 0.89$	$F(1, 61) = 0.86, p = 0.36$

and $p = .065$ respectively, for child self-report (see Table 9). Follow-up t-tests showed a time effect ($p = .037$) for child self-report suggesting the Microskin™ intervention participants perceived a significant decrease in family functioning problems.

3.2.4.1. Age. A significant main effect for age was revealed for FAD child report, $F(1, 33) = 4.796, p = .036$, the younger group ($M = 1.79, SD = 0.38$) reporting fewer family problems compared to the older group ($M = 2.10, SD = 0.47$). No significant results were found for parent report.

3.2.4.2. Gender. For the intervention group males reported significantly more family functioning problems at Time 1 ($M = 2.24, SD = .34$) than at Time 2 ($M = 1.87, SD = .27$), Wilks Lambda = .86, $F(1, 33) = 5.35, p = .027$, compared to females ($T_1: M = 1.93, SD = .54; T_2: M = 1.82, SD = .63$), Wilks Lambda = .97, $F(1, 33) = 1.17, p = .29$. For parent report no interaction or main effects were found.

3.2.4.3. Visibility. Children with visible scarring reported significantly fewer family functioning problems following the intervention ($T_1: M = 1.83, SD = .46; T_2: M = 2.10, SD = .50$), Wilks Lambda = .85, $F(1, 33) = 6.01, p = .02$ whereas participants with non-visible scarring did not ($T_1: M = 1.89, SD = .51; T_2: M = 1.84, SD = .71$) did not, $F < 1$. No significant interactions or main effects were found in parent reports.

3.2.5. Microskin™ questionnaire

Descriptive results are based on child self-report following completion of 8 weeks Microskin™ intervention. They reported that 43% applied Microskin™ greater than once per week, 20% every 4–7 days, 8.6% every third daily and one participant applied it daily. The majority (65.3%) found Microskin™ easy to apply, the rest (34.6%) finding it 'ok'. Only 11.5% found it 'hard' to learn how to use the equipment and apply Microskin™. All children reported scars looked

better with Microskin™ (65.4% 'Much better'). Most participants (96.2%) were not aware they were wearing Microskin™; only one participant reporting it 'sometimes' limited activity. Only 16% reported side effects, two not giving a reason, one reporting that she was unhappy with the colour "my face going green", and the other stated 'my face got very red and dry and itchy but on other parts of the body it was good'.

Generally, children reported feeling 'happier' (88%), more confident (84%), and more comfortable in social experiences (54.3%) with Microskin™ applied. Similar to Martin et al. [32] 'fitting in' did not appear to be strongly influenced by applying Microskin™ with 52% reporting positively. In contrast, 68% agreed 'Children don't look at my scars when I have Microskin™ on'. All the children reported they would continue using Microskin™.

Minimal differences between child and parent self-report were found. No differences were reported regarding the actual product, its useability, or the process of learning to use the equipment and application techniques. Minor differences existed about the impact of Microskin™ with caregivers not reporting quite as positively as the children themselves. Caregivers were slightly less likely to agree their child was happier (80.7% compared to 88% for the children), more confident (73.2% compared to 84%), that other children looked at their child's scars less (61.5–68%), and that their child was more comfortable with social experiences (48.6% compared to 54.3%). Caregivers reported no change or less change (57.6%) regarding their child's participation in activities with friends such as parties and movies.

4. Discussion

Children and adolescents experience long-term psychosocial difficulties post-burn. Both the trauma of the injury, treatment and hospitalisation, long-term scarring and societal influences

Table 9 – FAD group and time effects and main interactions between group and time.

Outcome	Effect		
	Group	Time	Group × time
FAD			
Child self report			
Total score	$F(1, 61) = 3.52, p = 0.065$	$F(1, 61) = 3.58, p = 0.063$	$F(1, 61) = 1.01, p = 0.319$
Parent report			
Total score	$F(1, 61) = 0.27, p = 0.61$	$F(1, 61) = 0.9, p = 0.345$	$F(1, 61) = 0.001, p = 0.975$

contribute to these difficulties. Camouflage clinics have shown positive results in regards to improved psychosocial functioning with adults [8] and more recently with children [32]. The present study set out to further explore the impact of cosmetic camouflage on the psychosocial functioning of children with burn scars and to determine if Martin and colleagues [32] results could be replicated.

The health-related quality of life of the participants in the intervention group improved significantly over the course of Microskin™ particularly on the socialisation subscales such as social and school functioning as well as perceived physical appearance. This was reported similarly by participants and caregivers. It must be noted that there was a significant difference in PPA scores between the two groups at baseline with the wait-list group reporting significantly lower PPA than the intervention group which may have influenced results.

This study has also revealed that children and adolescents with visible scarring socially struggled much more than those with non-visible scarring. The adolescents and the girls in the sample also reported that their perceptions of physical appearance improved significantly whilst using the camouflage. This study did have a significantly greater number of females than males which may have influenced results. It may be that the cosmetic camouflage was considered 'make-up' which in Western society is seen as a female activity and not well accepted as a male activity. The idea that cosmetic camouflage is a 'make-up' may also have been an issue for staff recruiting into this study and more females may have been approached to participate than males. It could also be argued that females tend to be more conscious of their physical appearance due to societal norms and therefore may have been more enthusiastic to use and respond positively to the intervention. Irrespective of this, these results have specific implications for young people with burn scars in terms of their ability and confidence to participate in social experiences whilst living in a society that has specific expectations and opinions about appearance [20,21,46]. It has been found that due to the current societal influences that people who are seen to be attractive are also often assumed to be more intelligent, kind, and successful [47]. These expectations are often very difficult to manage for adolescents and more so for adolescent girls as this is a time in development where acceptance from peers is paramount and a visible difference such as scarring can lead to difficulties in acceptance. The use of a camouflage may provide some reprieve from negative social experiences for these children as they move through childhood and adolescence.

When the sample used in the present study was compared with healthy norms for self-concept the scores were found to be in the normal ranges [48] therefore achieving a statistically significant improvement in these scores post-intervention was difficult. However there appears to be a clear difference in reporting between the constructs of self-concept and health-related quality of life particularly in terms of perceptions of appearance. This sample reported lower scores on the perceived physical appearance subscale at baseline compared to the other PedsQL subscales (see Table 2), furthermore significant improvements were found on this subscale post-intervention however for the appearance and physical attributes subscale on the Piers-Harris self-concept scale the

participants reported within normal ranges [48] with no change over the course of the intervention. The self-concept scale asks general dichotomous questions "I have nice hair" rather than "Are you embarrassed when others see your scars". This indicates the importance of burn and scarring specific questions being asked of this population to gain a true reflection of their perceptions and thoughts about their appearance and scarring, how this impacts on their overall functioning and whether camouflage can improve overall functioning. The PedsQL perceived physical appearance results indicate that cosmetic camouflage can indeed have a significant impact on perceptions of scarring and appearance. This is clinically significant as long-term patients can often appear to be coping well however struggling internally [21] and allied health, medical and nursing staff often do not ask specific and difficult questions during follow-up appointments regarding patients' long-term adjustment, coping and acceptance of their altered appearance.

For the SDQ, significant improvements after Microskin™ were found for a number of the subscales related to social interaction including a decrease in peer problems for child and parent report, emotional symptoms for the child report and the total score. Fewer peer problems were also reported over the course of the intervention for the adolescents, the girls, and those with visible scarring for both child and parent report. The overall behaviour of the adolescents and the girls in the sample as reported by the participants themselves also improved significantly whilst using the cosmetic camouflage. These findings show that burn scarring can impact significantly on peer relationships, overall behaviour and social acceptance. This fits with Lawrence et al.'s [49] finding that social comfort is correlated with body esteem and that interventions aimed at improving body esteem should include a social comfort component (e.g., cosmetic camouflage). The present results indicate that cosmetic camouflage can be a positive intervention for these children in respect to socialisation.

Family functioning from the child's perspective also appears to have been impacted by the use of the cosmetic camouflage, with family functioning improving significantly during the intervention. The male children compared to the female children seemed to think that their family functioning was greatly influenced by the intervention. Parents did not report similarly. As the children experienced an improvement in quality of life and felt happier and more confident with Microskin™, stress, worry and unhappiness may have also reduced for both the child and other family members resulting in the child perceiving that their family's functioning had indeed improved.

When comparing baseline parent and child report mean scores, parents tended to report lower quality of life and more behavioural difficulties than the children [48] which differed from some burn literature on parent-child concordance [50]. The present study found more statistically significant differences on the PedsQL and SDQ for parent report than the child report indicating that caregivers reported more improvement after camouflage than the children. This demonstrated that this sample of caregivers felt Microskin™ as an intervention increased the quality of life and decreased behavioural difficulties for their children. This result may be showing the struggles and worries parents experience in respect to

acceptance, adjustment and their perceptions of their child's social interactions rather than what children truly feel or experience. Although the camouflage may not have had a significant effect on self-concept it seems to have improved participants' quality of life, particularly perceived physical appearance, decreased behavioural problems and enhanced their ability to interact and function socially.

This sample also responded very positively when asked questions about Microskin™ itself and whether it made a difference to how they felt and their ability to participate in social situations. It seems that as their scars which are unique in appearance and obvious to others' are minimised by the application of Microskin™, it gives participants increased potential to feel comfortable participating and interacting socially and with their peers. This study demonstrates that cosmetic camouflage is a valid tool for children and adolescents with burn scarring to add to their collection of coping strategies.

5. Limitations

There were a number of study limitations that must be considered. The original planned sample size was not achieved due to a number of barriers e.g., most sites having no available records or databases to easily identify and access long-term patients. Logistical problems with recruitment are unfortunately common in burns research [49] and multi-centred research when study sites may have differing priorities and time available to give to the study [51]. In addition, the study also experienced a high rate of attrition (see Fig. 2: Consort Diagram). Perhaps the demographic characteristics of the sample, including low education and low socio-economic status of a paediatric burn population, may account for this high attrition.

A wait-list design was chosen for this study as camouflage is not part of standard treatment and from an ethical base it seemed necessary to offer the control group the intervention as well as the initial intervention group. A concern with the wait-list design was that possibly once participants and their caregivers were aware of an intervention available to conceal their scarring, they may become optimistic which would impact the scales otherwise known as the Hawthorne effect [52]. It appears that this may have occurred for the PedsQL child report social functioning and parent report emotional functioning as well as the SDQ parent report hyperactivity-inattention subscale as the scores for these subscales for the wait-list control group increased whilst waiting for the intervention. Considering the total number of total scores and subscales only a few have had these unexpected increases which could be explained by the Hawthorne effect or by other external factors to the study that could not be controlled, however this occurrence is a limitation of the study that must be considered.

No stipulation was placed on participants regarding the frequency of camouflage use and no specific data was collected regarding this (e.g., a diary record). This may have been a useful addition to the measures as further analysis could have been conducted. Another limitation may have been the time and effort involved in applying the product using the

air compressor and brush. A further limitation of the study is that no data was gathered from participants' regarding other potential psychosocial stressors occurring in their lives during the data collection period.

6. Conclusion

This RCT of children and adolescents (8–17 years) with burn scarring using the cosmetic camouflage (Microskin™) found improvements for psychosocial functioning for this population specifically for areas related to socialisation. Peer relationships, social functioning and perceptions of physical appearance improved significantly whilst using the camouflage. It has already been shown that this population can struggle socially to find acceptance of self and by others' as well as to adjust to their scarring and altered appearance. Clinically, there is a need for sensitive and specific exploration of this topic as part of long-term psychosocial care for this population and their caregivers. This study has demonstrated that cosmetic camouflage can be a positive intervention option that provided in conjunction with other psychosocial support and interventions, might assist children and adolescents to actively participate socially with peers and within their communities. Further longitudinal research is needed in this area to explore the ongoing relationship between the use of camouflage, social comfort, perceived stigmatisation and physical appearance more directly for children and adults with burn scarring.

Conflict of interest

This study was supported financially by Queensland Children's Medical Research Institute PhD Scholarship program, University of Queensland and the Royal Children's Hospital, Queensland Health as well as Microskin™ International who contributed to researcher travel costs and the supply of the Microskin™ products to participants. Microskin™ International did not contribute in any way to the study design, data collection or analysis of results from this clinical trial.

Acknowledgements

I wish to acknowledge the children and caregivers that participated in this study as well as the staff of the various study sites involved, particularly Frances James and Dr. Richard Wong She, Middlemore Hospital, NZ; Linda Quinn, Women's and Children's Hospital, Adelaide, SA; Michelle Adamson and Tania McWilliams, Princess Margaret Hospital for Children, Perth, WA; Sandra Spalding and Dr. John Harvey, Westmead Hospital for Children, Sydney, NSW; Rebecca Schrale, Royal Hobart Hospital, Hobart, TAS. Queensland Children's Medical Research Institute PhD Scholarship program, University of Queensland and the Royal Children's Hospital, Queensland Health are also acknowledged for their support and financial contribution to this study as well as Microskin™ International for their contribution to researcher travel costs and supply of the Microskin™ products to participants.

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