The Effect of Rehabilitative Care Provided to Individuals In an Inclusive Space Following Gender-Affirming Top Surgery

Elena Hobbs

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Signed by the final Examining Committee:

_____Chair
Jacqueline Camley

_____Examiner
Dr. Angela Alberga

_____Examiner
Dr. Maryse Fortin

_____Thesis Supervisor
Dr. Geoffrey Dover

Approved by _____
Chair of Department or Graduate Program Director

_____, 2024 _____
Dr. Pascale Sicotte, Dean of Faculty

Abstract

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Elena (Ele) Hobbs

Gender-affirming top surgery is an important procedure for members of the 2SLGBTQIA+ community. There are currently no standardized aftercare recommendations nor consistent timelines for rehabilitation following top surgery. The purpose of our study was to measure patient-reported outcomes, including upper limb function, pain interference, neuropathic pain, embodiment, role limitations due to physical health, social functioning, and general health, in individuals receiving top surgery, over an 11-week rehabilitation program.

Forty-two gender diverse individuals from the general population participated. Participants started individualized rehabilitative aftercare 10-days post-operatively, which included one 60-minute treatment per week, for 11-weeks. The Disabilities of the Arm, Shoulder, and Hand scale (DASH) and 4 other questionnaires were completed prior to surgery, then again at weeks 1, 5, and 11 post-op. Separate repeated-measures analyses of variance (ANOVA) were used to identify differences in all measures among the 4 time points.

After top surgery individuals experience significant disruption to upper limb function, similar to other invasive upper extremity surgeries. During the rehabilitation, our participants experienced a significant statistical and clinical improvement in upper limb function while pain was not a limiting factor during the treatment. Participants reported avoiding about 3 less environments or social experiences which represents a clinically significant improvement in patient-reported embodiment.

The results of our study demonstrate the benefit of standard post-operative rehabilitative care in patients undergoing gender-affirming top surgery. The timeline for rehabilitative care used in this study can be applied, by qualified care providers, for future individuals who have undergone gender-affirming top surgery.

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"*The first duty of any queer person is to survive.*"
– Esther Newton

The second, is to take care of each other.
For the gender creatives.

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Concept, design, and all writing was completed by EH.

LA contributed to the Tukey HSD post-hoc analysis, included in the appendix.

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Introduction

Unobstructed access to healthcare, as well as trauma-informed mental health services, are needed to improve the health and wellbeing of two-spirit, lesbian, gay, bisexual, trans, queer, intersex, asexual, as well as other sexual and gender minority (2SLGBTQIA+) people in Canada. With improved government funding, which now provides access to gender-affirming healthcare, such as hormone replacement therapy and some surgical procedures, there has been an increase in the number of individuals accessing these services.[1] The increased demand for gender-affirming surgical procedures specifically, has quickly surpassed the availability of care, as well as the time needed to develop an integrated support network of qualified providers, in order to deliver a multidisciplinary aftercare approach.[1] Additionally, rehabilitative care following any gender-affirming surgical procedure is not government funded, creating a financial barrier to access. Often, the result is no aftercare, leading to widely varied perioperative experiences and post-operative functional outcomes. The variability of functional outcomes drives the need for the development of efficacious rehabilitative protocols. Of the available gender-affirming surgical procedures, chest (top) surgery (i.e., chest tissue reduction, augmentation or bilateral mastectomy) is often the first, and sometimes the only surgical procedure sought by trans and gender diverse individuals.[2] Top surgeries have a high rate of post-operative satisfaction[3,4] and have been shown to have a positive impact on mental health,[5] indicating how important it is that individuals have access to these procedures. However, there are currently no standardized aftercare recommendations nor consistent timelines for rehabilitative care following top surgery.

In a cohort of 260 gender diverse individuals, de Brouwer et al. found that despite high post-operative satisfaction, nearly half of the participants reported wanting more assistance during surgical recovery.[5] Recovery following top surgery is a lengthy process. A study that followed a cohort of 26 participants for at least 6-months following top surgery indicated that 16-months of rehabilitation was required before physical and psychological effects were fully achieved.[6] It is also likely to take longer for trans and gender diverse individuals to fully integrate the positive effects of top surgery in order to recentre themselves in their new body.[6] While long term aesthetic and functional outcomes following any gender-affirming surgical procedures likely depend on access to adequate aftercare, little is known about the specific post-operative needs of trans and gender diverse individuals undergoing top surgery.[5] The limited availability of outcome measures validated for use in trans and gender minority individuals, paired with inconsistency in the outcomes being measured, make it difficult to determine the efficacy of the gender-affirming care that is being provided.

Therefore, the purpose of this study is to follow improvements in shoulder function, pain interference, neuropathic pain, embodiment, role functioning due to physical limitations, social functioning, and general health through the provision of standard rehabilitative care, in an inclusive environment, following gender-affirming top surgery.

Gender Minorities: Challenges Accessing Healthcare

Two-spirit, trans, non-binary, and gender minority/diverse individuals represent a group within the 2SLGBTQIA+ community that experience significant disparity when it comes to ease of access to queer and gender healthcare, specifically those who are undergoing gender-affirming surgical procedures.[7,8] Gender minorities often experience discrimination, oppression and marginalization which are associated with increased rates of verbal, physical, and sexual violence, poverty, physical and mental illness, all of which create barriers to accessing healthcare.[9] In a 2019 survey, Trans Pulse Canada found that 45% of the 2873 respondents reported having one or more unmet healthcare need(s) in the past year (i.e., unable to access sexual, gender-affirming, or mental health services), while 12% reported having avoided the emergency department.[8] Despite the many manifestations of oppression and marginalization in the lives of gender minority individuals, some of these impacts may be lessened or avoided entirely if these individuals have unobstructed access to consistently positive experiences in healthcare.[9]

Importance of Inclusion of Gender Minority Individuals in Healthcare

Comfort is integral in all healthcare interactions. Through qualitative semi-structured interviews, Harbin et al. highlight that comfort in healthcare interactions is especially important between queers and their providers.[10] Nineteen self-identified queer women were interviewed regarding their health and healthcare experiences, along with 10 physicians who were interviewed regarding where they felt the most and least confident in their patient interactions.[10] Inductive analysis showed that healthcare interactions

may improve if queers and practitioners are better able to navigate their mutual discomfort together.[10] Past negative experiences, confidentiality concerns, and fear of transphobic reactions or being stigmatized result in avoidance by trans and gender minority individuals to disclose their identity to healthcare providers.[11] Disclosure of gender identity is only likely to improve care if individuals are met by adequately prepared providers who offer culturally competent and well-informed services in return.[11,12] A survey of 380 trans individuals in Ontario estimates that 38% of participants had prior transphobic or negative healthcare experiences while approximately half reported discomfort discussing gender-related health concerns with their doctor.[13] By creating a welcoming care environment that promotes communication that is non-judgmental, gender-appropriate, and professional, trans and gender diverse individuals will feel as comfortable as their cisgendered / heterosexual peers when discussing matters of their health.[11,14] The rehabilitative care provided in this study will be sensitive to historical stigmatization, informed by the continued barriers to accessing care, and will demonstrate awareness of cultural experiences in all interactions with 2SLGBTQIA+ individuals.[11] There is a fine line between ensuring trans and gender diverse individuals can be open and honest about their identities while also respecting their privacy and sense of safety. Contextual factors, such as physical, psychological, and social elements, are present in therapeutic interactions between patients and healthcare providers, while having a direct impact on the quality of rehabilitative outcomes.[15] As such, it is integral to clearly and correctly identify these contextual factors in order to enhance treatment outcomes.[15] This is especially important when providing care to trans and gender minority individuals, who are more likely to have

experienced higher rates of verbal, physical, and sexual violence as well as previous negative experiences in healthcare.[9] Establishing consent to touch, treat or proceed with an intervention is important prior to all healthcare interactions as is re-establishing this consent throughout the duration of the interaction. While touch is an important means of communicating empathy, which can help make pain more bearable and heal damaged self-esteem, not all touch is therapeutic.[16] For example, patients living with schizophrenia often experience sensory changes resulting in altered perceptions or heightened sensitivities to touch.[17] A previous study indicated how important consent to touch was for this population by reiterating that care workers must be able to set appropriate boundaries, justify the use of touch, provide patients with detailed explanations regarding the purpose of touch, and highlight potential risks, while providing ample opportunity for the patient to ask questions.[16] Similar to the previous study, when working with gender minority individuals, who are more likely to have lived experiences of trauma or violence[9], providers must be transparent regarding what is being done during hands-on treatment, confirm what emotions or sensations the individual is experiencing due to the treatment, and check in often, in order to avoid eliciting a negative treatment outcome.[15] In this manner, individuals receiving post-operative care following top surgery will feel more comfortable accessing and navigating healthcare with a renewed confidence in the system. While the effect of therapeutic touch is important to keep in mind and clinically relevant, especially during interactions with trans and gender minority individuals where so little information is available, it is beyond the scope of this thesis.

Top Surgery: Description and Importance

Top surgery is a unique and invasive procedure that consists of chest tissue reduction, augmentation using pre-pectoral implants, or bilateral mastectomy with or without free nipple areola complex grafts.[18–20] Top surgery procedures are empowering, allowing trans and gender diverse individuals to experience improved body satisfaction, self-esteem, and quality of life.[6] A survey of 92,329 binary and non-binary transgendered respondents by James et al. found that 97% who had undergone at least one form of gender-affirming surgery reported being "a lot more satisfied" (88%) or "a little more satisfied" (9%) with their lives.[21] Looking at satisfaction rates specifically following top surgery, a study by van de Grift et al. found that of 132 participants surveyed, 96% of those who had chest augmentation (n = 33) reported being satisfied with the outcome, as did 94% of those who underwent bilateral mastectomy (n = 49).[4] A survey of 46 surgeons, cumulatively responsible for the treatment of between 18,125 and 27,325 trans or gender diverse individuals, calculated that the overall rate of post-operative regret following gender-affirming surgical procedures was 0.2% to 0.3%.[22] Comparatively, a systematic review that included 55 articles compared the rate of regret following gender-affirming surgery to regret following plastic surgeries, elective surgical procedures and other major life decisions.[23] The review highlighted that 47.1% of plastic surgery patients experienced some form of regret following breast reconstruction surgery,[24] 30% of elective surgery patients experienced decisional regret following prostatectomy,[25] 7 to 13% of parents expressed regret regarding having children,[26] and 16.2% of individuals expressed regret after the "relatively permanent body modification" of getting tattooed.[27] These much higher rates of post-operative satisfaction following

top surgery, compared to the rates of satisfaction following most plastic and elective surgeries, as well as other major life decisions highlights the need for access to gender-affirming care and also the importance of embodiment – gender minority individuals need to feel comfortable and centred in their bodies. Improving mental health on a societal level is important, but it is especially important in the gender minority population where the rates of depression and anxiety are significantly higher. According to the 2019 Canadian Trans and Non-binary Youth Health Survey, 88% of respondents reported having a mental health condition, such as depression or anxiety while only 16% listed their mental health as good or excellent.[28] A total population prospective study of 2,679 gender diverse individuals living in Sweden examined mental health treatment, from 2005 until 2015, compared to time since gender-affirming hormone and surgical treatment.[29] While there was no significant association between years since initiation of hormone treatment and the likelihood of receiving mental health treatment, time since gender-affirming surgery was significantly associated with a decrease in mental health treatment.[29] Additionally, the likelihood of receiving mental health treatment was reduced by 8% for every year since having undergone the last gender-affirming surgical procedure.[29] These clinically important results highlight the decreased need for mental health services by individuals following gender-affirming surgical procedures, which exemplifies the positive benefits of these procedures. While some top surgeries are funded Canada-wide, post-operative rehabilitative care is left to the discretion of each individual, often leading to no care. The result is a wide range of post-operative outcomes, contingent on the ability of each individual to overcome a myriad of socioeconomic barriers in order to access rehabilitative care.

Top Surgery: Current Treatment and Relation to Breast Cancer Surgery

Most recommendations for rehabilitative care following top surgery draw from current breast cancer research — generally, bilateral mastectomy with or without pre-pectoral implants — as it is the closest comparison in terms of surgical procedure. Similar to breast cancer surgery, top surgery consisting of bilateral mastectomy is guided by four main principles: removal of breast tissue and excess skin, harvest and positioning of the nipple-areola complex graft, elimination of the inframammary fold, and minimizing chest wall scars.[30,31] Top surgery consisting of augmentation, similar to reconstruction with pre-pectoral implants in oncology, generally involves an inframammary incision followed by placement of a round silicone gel implant into a previously irrigated subfascial pocket.[32] Breast cancer surgery, as with top surgery, disrupts the chest wall and axilla which may cause scarring and soft tissue injury, leading to tightening and contracture of muscles and connective tissues across the shoulder and chest.[33,34] Additionally, many surgeons recommend patients undergoing breast cancer surgery respect a 1 month period of shoulder and upper arm immobilization to prevent surgical site complications.[35] This period of post-operative immobilization and chest tissue tightening can result in reduced range of motion (ROM) in the shoulder, muscle weakness, pain and functional limitations.[33–36] Restrictions of shoulder ROM, specifically in flexion, abduction, and abduction with external rotation are common following breast cancer surgery.[37] A study comparing shoulder mobility following 2 weeks or 1 month of post-operative immobilization paired with an exercise program found that participants in the shorter immobilization group had greater shoulder flexion at 2 months following breast

cancer surgery.[35] Loss of ROM and muscle strength negatively affects activities of daily living (ADLs) resulting in poorer quality of life, and can increase risk of comorbidity as well as mortality in any population group.[38,39]

Previous Research: Improving Patient Outcomes Following Breast Cancer Surgery

ROM exercises may prevent shortening and weakness of the surrounding muscles and connective tissues that can occur following breast cancer surgery.[34,40,41] There is significant evidence that post-operative exercise may improve shoulder function in patients with breast cancer, however there is limited research regarding the optimal content and timing of these exercise interventions.[33,36] Insufficient descriptions of interventions hinders replicability in future studies which then delays implementation into standard care for interventions found to be effective.[37] Due to the methodological weaknesses of previous trials investigating the effectiveness and safety of post-operative exercise in patients with breast cancer, the National Institute for Health Research Health Technology Assessment (United Kingdom) commissioned The Prevention of Shoulder Problems (PROSPER) trial.[37] The PROSPER trial is a large-scale, multicentre, randomized control trial evaluating the clinical and cost effectiveness of early exercise following breast cancer surgery.[33,37] The primary outcome measure was upper limb function at 12 months using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire[42] while secondary outcomes included DASH subscales (i.e., activity limitations, impairment, and participation restriction)[43], post-operative pain (i.e., acute, chronic, and neuropathic pain)[44], wound-related complications (i.e., surgical site infection, seroma, and wound healing), lymphoedema and quality of life[45]. The trial randomised participants who had undergone breast cancer surgery into a usual care

group (n=139) or a group who received a structured exercise intervention alongside the usual care (n=135).[45] Usual care consisted of information leaflets while the intervention group received a physiotherapist-led programme that incorporated manual therapy, stretching, strengthening, physical activity, and behavioural change techniques to improve exercise adherence.[45] Both primary and secondary outcome measures were collected at baseline on enrollment, at 6 weeks, then again at 6 and 12 months following randomization.[37,45,46] Using the DASH questionnaire, the minimum clinically important difference for adults with acute or chronic upper limb conditions is 5 to 10 points, which suggests a moderate functional improvement.[47,48] The clinically significant mean difference in DASH scores, in favour of the exercise intervention, highlight that active ROM exercises and some manual therapy techniques are essential in order to regain shoulder function as well as to prevent muscle shortening following a period of post-operative immobilization in patients with breast cancer (unadjusted mean difference in DASH 7.34 [95% confidence interval: 2.44 to 12.23; P<0.01]; adjusted mean difference in DASH 7.81 [95% confidence interval: 3.17 to 12.44; P=0.001]).[37,45] Early ROM exercises had beneficial effects on shoulder flexion and abduction in the short and long term, without increased risk of seroma, no delay to wound healing, and no increase in post-operative pain.[37] At 12 months post-randomization, participants in the exercise intervention group reported significant improvement on all DASH subscales, lower post-operative pain intensity (adjusted mean difference in numerical rating scale −0.68; −1.23 to −0.12; P=0.02), and fewer functional limitations in the upper extremity, when compared to participants in the usual care group.[45] The results of the PROSPER trial are potentially generalizable and applicable to gender minority individuals undergoing

top surgery. As exercise and manual therapy have been shown to improve functional outcomes following breast cancer surgery[37], individuals undergoing top surgery could also benefit from individualized aftercare that improves upper limb function and quality of life. It is unclear how prevalent neuropathic pain and altered chest wall sensation are following top surgery. However, sensory changes to the chest wall, thorax, and axilla are quite common following mastectomy.[49] During surgery, the peripheral nerve fibres that become primary skin sensory neurons are cut.[49] Through the development of a proximal stump that traverses the scar tissue to reach the distal part of the nerve fibre, these sensory neurons are able to regenerate.[49] A study by Khan et al. examined the thermal sensibility and light sensory touch in 145 breast skin envelopes of 94 participants after having undergone either mastectomy for cancer treatment (n = 77) or risk-reducing mastectomy (n = 68).[49] The results found that 6% of cases experienced severe loss of light sensation, while 24% experienced ongoing numbness, more than 1 year following surgery.[49] While breast cancer surgery and top surgery are orthopaedically similar procedures with similar post-operative rehabilitation, there is a unique psychological consideration with top surgery. The outcome of top surgery is a significant physical change thus post-operative rehabilitation has the added challenge of assisting gender diverse individuals to recentre themselves in their new body in order to optimize post-operative satisfaction. This is where providing aftercare in an inclusive and welcoming space is crucial – individuals must feel comfortable and at ease in order to achieve a renewed sense of embodiment.

Top Surgery: Need for Post-Operative Care

While appropriate post-operative care is considered integral for good treatment outcomes following any type of surgery,[50] a substantial number of individuals undergoing top surgery receive limited clinical follow-up.[51] This is compounded by the lack of evidence regarding the experiences and aftercare needs of individuals undergoing top surgery.[5] An international follow-up to a cohort study surveyed 260 participants, following gender-affirming surgeries, regarding their aftercare experiences and additional post-operative needs.[5] Among this cohort, 65% (n = 169) participants reported the need for additional post-operative care and the most frequently requested need (n = 123, 47%) was for more assistance in surgical recovery.[5] Similar to recovery after breast cancer surgery, convalescence following top surgery is a long process. It is not clear what post-operative care plans should address nor is there a widely accepted standardized aftercare protocol for top surgery.[5] Following breast cancer surgery, one trial found that shoulder ROM above 90 degrees from the first post-operative day resulted in a significantly greater risk of lymphoedema when compared to restricting shoulder ROM to below 90-degrees for the first week.[52] In accordance with these findings, post-operative movement recommendations following top surgery include gradually returning to movements of daily living, as tolerated, while avoiding sweeping movements and movements that provoke any pulling sensations along the incision wounds, as well as to avoid lifting more than 4.5 kg for the first 4 weeks.[53] Some surgery centres say individuals can expect to return to ADLs and work around 4 to 6 weeks following top surgery, with the return to intense physical activity at 6 to 8 weeks.[54] However, the physical and psychological effects of top surgery may not be

fully achieved up to 16 months post-operatively.[6] There is a paucity of peer-reviewed data that includes rehabilitative protocols following top surgery, though anecdotally, most individuals receive conflicting recommendations. For example, when searching online for aftercare instructions following top surgery, there is information such as: "individuals should plan to maintain elbows-below-shoulders for 3 months following top surgeries that involve a double-incision (i.e., bilateral) mastectomy,"[55] which is significantly different from other recommendations, including those from most surgery centres. A 7 year retrospective cohort study of 209 adolescent participants found that the median post-operative follow-up length was 2.1 years following gender-affirming top surgery.[56] Of this cohort, 137 participants received follow-up of at least 1 year post-operatively, 7.3% (n = 10) for complications and 10.9% (n = 15) for revisions [56]. The low number of participants who sought follow-up care for revisions or complications (n=25; 18.2%) at least 1 year post-operatively suggests that the remaining 112 participants had yet to experience full physical and psychological healing by the 1-year mark and continued to seek follow-up care. The variability in post-operative recommendations and timelines for healing further highlights the lack of consensus and formal guidelines to inform top surgery aftercare.

Top Surgery: Rehabilitation Timeline

The start of the aftercare timeline is marked by the removal of surgical suction drains, if present, around 7 to 10 days post-operatively. Drain removal is done "once [the] volume of the liquid drained is less than 30 mL for a period of 24 hours or if the bulb inflates immediately after closing the cap."[53] Removal of surgical suction drains by a nurse or

healthcare provider marks the first clinical contact following top surgery. In cases with nipple-areola complex grafts, bandages are removed approximately 7 days after surgery, while wound closure strips are removed 3 weeks post-operatively if the adhesive has not already sloughed off.[53] The recommended timing and duration for patients to wear a compression vest or elastic wrap following top surgery is another example of conflicting evidence regarding the rehabilitation timeline. Compression around the torso with an elastic bandage wrap, or a properly fitted compression corset (vest), is recommended for the first 4 weeks following top surgery.[53] However, in patients with breast cancer undergoing mastectomy, it is recommended to wear a compression vest or elastic wrap within 1 month of surgery and not necessarily immediately following.[57] The constant external pressure of wearing a compression vest or elastic wrap following mastectomy is effective for antiedematous prevention, pain reduction, and has been found to help maintain treatment results when worn for up to 7 months post-operatively.[57] Assuming no infection or other issues arise, follow-up with the surgeon is approximately 1 month post-operatively.[53] Flattening of the incision wounds is a significant detail of the healing process. Complete dissolution of all layers of stitches occurs 30 to 90 days post-operatively,[53] while collagen production and degradation has an effect on the incision lines for approximately 6 months post-operatively.[58] In the 9 to 12 months following top surgery, there is a natural skin retraction which allows for correction of any residual laxity around the incision sites.[54] In order to optimize flattening of the wounds, massage using silicone gel or vitamin E is recommended once the incision wounds are fully closed, usually as of the 6 week mark.[53] Post-operative function following top surgery has never been assessed using

performance outcomes and no rehabilitative guidelines currently exist for chest care specific to the trans and gender diverse population, yet long-term outcomes may depend on access to adequate aftercare.[5,59] A systematic scoping review charted data for outcome measures following gender-affirming top surgery.[59] It included 47 studies and considered the following items: complications, need for reoperation or revisional surgery, aesthetic outcomes, nipple-areola complex sensation, and other patient-reported outcome measures.[59] The summary of items and outcome measures highlighted that there are large variations in outcome evaluation between studies.[59]

Outcome Measures: Body Dysmorphia Versus Embodiment

There is limited research that acknowledges the body image of trans and gender diverse individuals without utilizing a framework of psychopathology.[60] The few available studies that do aim to measure body image in the gender minority population do so through the lens of disordered eating or by focusing on body dysmorphia or body dissatisfaction.[60–64] Body dysmorphia, whereby an individual demonstrates a severe preoccupation with a perceived bodily defect that may not be noticeable to others, is listed as a mental health condition in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5-TR, American Psychiatric Association).[65] Other recent studies commonly rely on outcome measures extrapolated from existing scales, which are designed for implementation in a cisgendered or heterosexual population, and attempt to apply them to a gender diverse population.[1] Questionnaires such as the Body-Image scale[66], the Appearance Schemas Inventory – Revised[67], the Body Image Quality of Life Inventory (BIQLI)[68], the Body Dysmorphic Disorder Symptoms Scale (BDD-SS)[69], the

Body-Q[70], and the Chest Dysphoria Scale [71] are all examples of outcome measures that center cis/heteronormative and binary body ideals: thinness in women[72] and muscularity in men[73]. Outcome measures that use such binary metrics, presenting thinness as being synonymous with women and muscularity as being synonymous with men, as well as suggesting that the only options are to identify as a man or a woman, are unlikely to resonate with members of the gender minority community, who likely do not articulate their gender experience using such binary language. This means that the per item responses and overall scores on these types of questionnaires are unlikely to accurately measure how trans and gender diverse individuals feel in their bodies. Additionally, these questionnaires take inventory of body image "symptoms" in ways that are pathologizing: suggestive of unhealthiness or psychological abnormality.[61] As a specific example, the BIQIL, a 19-item scale to quantify the impact of body image on self-experiences and life contexts, asks users to rate how body image affects "feelings about [their] adequacy as a man or a woman" or "feelings of masculinity or femininity" from -3 (very negative effect) to 3 (very positive effect), with 0 indicating "no effect."[68] This gendered conceptualization then reflects white, binary, and cisnormative notions of body image and ideals while also failing to capture the uniqueness and ever evolving complexity of gender identity.[61] In the trans and gender diverse population, who are already struggling to achieve their own individual body ideal, using the wrong scale could potentially further reinforce societally rampant cisnormative body ideals, leading to decreased body image satisfaction following gender-affirming care. When providing gender care, it is essential to know what type of outcomes and results are considered desirable by each individual, such as sexual well-being and body image, in order to fully

understand the impact and success of treatments.[70,74–78] These desired outcomes, the way an individual functions and feels before and after gender-affirming surgery or care, are best assessed by self-report.[70,79,80] Gender diverse individuals are likely to feel pathologized and like there is something “wrong” with them if the scales used to measure outcomes following gender-affirming treatments, such as top surgery, are based on cisnormative body image ideals. It is likely the results of these questionnaires would not be accurate and our participants would not feel comfortable completing them. A scoping review with the primary outcome of identifying outcome measures following gender-affirming top surgery specifically, included 47 studies and concluded that there is a high level of heterogeneity in the evaluation as well as reporting of top surgery outcomes.[59] As such, a valid and reliable patient-reported outcome measure for reception of gender-affirming care would also allow for pre- and post-intervention comparability between studies.[4,59] A scale that centers and respectfully considers the unique lived experiences of trans and gender diverse individuals is needed. The GENDER-Q is a potential solution to the current lack of patient-reported outcome measures and was designed specifically for the trans and gender-diverse population. As a mixed-methods outcome measure for adolescents and adults receiving gender-affirming care, the GENDER-Q is now in the final phase of international development but has not yet been established as valid and reliable.[80] The current version of the GENDER-Q is quite extensive and more than is needed to evaluate outcomes following top surgery alone. Additionally, there is currently no widely accepted, gold-standard scale to exclusively measure outcomes following top surgery. Since there is no validated scale to evaluate post-operative embodiment or body recentering following top

surgery specifically, it is difficult to determine the efficacy of post-operative rehabilitative care. In evaluating embodiment, it is important to identify the relative relationship between general shame and body shame in the clinical conceptualization of body dissatisfaction.[81,82] Shame is a painful self-conscious emotion felt in response to judging oneself as worthless or bad and is commonly elicited in response to perceived physical flaws, leading to overall bodily dissatisfaction.[81,83] These feelings of shame and subsequent body dissatisfaction can cause individuals to avoid certain situations in an attempt to prevent drawing attention to the perceived flaw. A study of 184 participants evaluated the relationship between general shame and body shame with overall bodily dissatisfaction.[82] The study used the BDD-SS[69] to measure the severity of distorted body image beliefs in individuals with eating disorders.[82] The findings showed that while body shame was more strongly related to bodily dissatisfaction, general shame was more likely to lead to adverse psychosocial outcomes, such as the avoidance of certain situations.[82] Post-operative embodiment following top surgery will be evaluated in the current study using the Avoidance Grouping of the BDD-SS[69], as it is a clinic-friendly and quantifiable patient-reported measure. Instead of quantifying gender incongruence, which is defined as a gender identity or gender expression that differs socially from the sex assigned at birth,[84] the BDD-SS Avoidance Grouping will be used to quantify the extent to which participants are able to recenter in their bodies following top surgery. The BDD-SS Avoidance Grouping asks individuals to endorse yes or no how often they have avoided certain behaviours, social interactions, public spaces and intimate or physical contacts in the last week.[69] While not perfect, as it was developed primarily for use as a measure of bodily dissatisfaction in a cisgendered population with eating

disorders,[69] the BDD-SS Avoidance Grouping will allow for the evaluation of pre- and post-operative embodiment by evaluating an individual's willingness or reluctance to engage in certain activities.

Significance

Providing quality rehabilitative care to trans and gender creative individuals requires providers to eschew pathologizing views and have gender-affirming attitudes, knowledge, and skills.[85] This study provided participants with post-operative rehabilitative care that was affirming, without judgement or assumption. As place and space are central to 2SLGBTQIA+ people, who operate within a society that is typically cisgendered, heteronormative and or heterosexist,[86] our participants were welcomed into a safe and inclusive clinical environment that was sensitive to lived experience of each individual and ensured that participants felt as comfortable as anyone else while accessing healthcare. Sessions were delivered in an environment that promoted open and honest communication, ensuring that participants were made to feel comfortable throughout their study enrolment. Each week, participants received 45-minutes of standard rehabilitative care, which combined manual therapy and exercise prescription. To supplement weekly appointments, participants were also provided instructions for four follow-up exercises to be done daily at home. Treatments were individualized to the ongoing rehabilitative and aesthetic goals of each participant. In order to provide care for trans and gender creative individuals in an ethical, thoughtful, and responsible manner, this study took a proactive approach, integrating valid and reliable theoretical knowledge with practical hands-on experience.[1] The previously highlighted benefits of

care following breast cancer surgery, which included manual therapy as well as ROM and strength exercises, were adapted and applied to top surgery aftercare.

The purpose of this study was to follow improvements in upper limb function, pain interference, neuropathic pain, embodiment, role limitations due to physical health, social functioning, and general health through the provision of standard rehabilitative care, in an inclusive environment, following gender-affirming top surgery. We hypothesized that trans and gender diverse individuals who received 11 weeks of individualized rehabilitative care following top surgery (i.e., augmentation, reduction, or bilateral mastectomy), in an inclusive and welcoming clinical environment, would experience improved upper limb function, decreased pain interference, fewer symptoms of neuropathic pain, an improved sense of embodiment, fewer role limitations due to physical health as well as improved social functioning and general health.

Methods

This single cohort longitudinal study tracked changes in 5 outcome measures from before to 11 weeks following gender-affirming top surgery. Functional outcome measures included upper limb function, pain interference and neuropathic symptoms from before to 11 weeks after surgery. Psychological outcome measures evaluated patient-reported embodiment, role functioning due to physical health, social functioning, and general health, pre- and post-operatively. In order to calculate the appropriate sample size for this project, a database search was done for previous studies that used the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire to measure upper limb function in gender diverse participants following gender-affirming top surgery but,

none were found. However, the closet comparison were studies that examined improvement in upper limb function using the DASH in a cohort of women who underwent surgery for breast cancer. In these studies, based on a 7-point change in DASH score, it was determined that 30 participants would be needed to achieve statistical significance.[87] Additionally, the aforementioned study and calculation were applied during a large and significant follow-up study that examined improvements in functional outcomes following breast cancer.[46] Therefore, for the purpose of the current study, the target sample size was 30 participants.

Inclusion and Exclusion Criteria

Eligible participants were scheduled to receive gender-affirming top surgery (i.e., chest tissue reduction, augmentation, or bilateral mastectomy with or without free nipple areolar complex grafts) within one month. Participants had to be available to attend all 11 post-operative appointments in-person, and therefore reside in the Greater Montréal Area. Participants had to also be fully capable of reading and writing in English or in French, be at least 18 years of age by program start and be willing to provide written informed consent. Anyone under the age of 18 or who was going to receive physical rehabilitation at the same time from another clinic was excluded.

Outcome Measures

Disabilities of the Arm, Shoulder, and Hand – (DASH)

The DASH questionnaire was used to measure upper limb function pre- and

post-operatively. The DASH is a 30-item self-report questionnaire that measures physical function and symptoms in patients with musculoskeletal disorders of the upper limb.[42] The DASH asks patients to rate their ability to perform certain tasks on a 5-point scale (1 = no difficulty, 5 = unable). The DASH is a valid and reliable measure of upper limb function and has been used in a similar population to measure function in patients recovering from breast cancer.[88]

Brief Pain Inventory: Short Form – (BPI)

The BPI evaluates pain intensity and the extent to which pain interferes with the individual's life. This self-report questionnaire is comprised of 12-items split into 2 components: a sensory component comprised of 4-items evaluating pain intensity at worst, least, average, and current level, with higher scores indicating worse pain as well as an affective component consisting of 8-items, ranked on an 11-point scale, with higher scores indicating increased functional interference due to pain. The BPI has been shown to be a valid and reliable measure in evaluating pain interference in post-operative cancer patients.[89]

Leeds Assessment of Neuropathic Symptoms and Signs – (LANSS)

We used the first 5 items of the LANSS to evaluate neuropathic pain in the participants. The first 5 items identify pain with neuropathic features, as well as any changes in sensation. Participants endorsed each item (yes or no), with each positive item receiving a different value (1, 2, 3, or 5). The entire LANSS scale is comprised of the first 5 items mentioned above, followed by 2 diagnostic tests which in total forms a 7-

item scale. The additional 2 items evaluate for allodynia and hyperalgesia. The total 7-item scale would give scores ranging from 0 to 24 with scores above 12 suggesting the presence of pain that is neuropathic in origin.[90] The LANSS questionnaire was found to be a valid and reliable instrument to evaluate neuropathic pain as well as to differentiate neuropathic pain from nociceptive pain in diabetic patients.[91] Due to time constraints during weekly appointments and the amount of scales the participants were filling out, the 2 diagnostic items were not collected. As such, the overall LANSS scores reported in this study range from 0 to 16, coming from the first 5-items.

Avoidance Grouping of the Body Dysmorphic Disorder Symptom Scale – (BDD-SS)

We used the Avoidance Grouping of the BDD-SS to measure embodiment before and after surgery. This subscale was the best option at the time of the study to measure this construct in this population. As previously stated, there were a few other scales that are specifically designed to measure bodily congruence and body image satisfaction in the gender minority population but do so in a way that is pathologizing. Using these questionnaires to measure embodiment in our participants would not give an accurate measure of their lived gender experiences. It is also likely our participants would be not be comfortable completing these questionnaires, which was not something we were willing to do while trying to provide an inclusive and welcoming care environment. Further justification comparing our use of the Avoidance Grouping of the BDD-SS to other scales can be found above. The full BDD-SS is a valid and reliable self-report measure of body dysmorphia disorder[69] and consists of 54 symptoms organized into 7 conceptually similar groups. Patients endorse (yes or no) which symptoms they have

experienced in the last week.[92] The Avoidance Grouping of the BDD-SS is comprised of 10 symptoms and has previously been used in a population not experiencing disordered eating.[93] Our study used the Avoidance Grouping to assess post-operative embodiment and feelings of bodily congruence as it is a clinic-friendly and quantifiable patient-reported measure. We used to quantify the extent to which participants were able to recenter in their bodies following top surgery, based on their willingness to engage in certain activities or not.

Short Form-36 Questionnaire – (SF-36)

To compare pre- and post-operative quality of life, participants completed the SF-36. The SF-36 is a self-report questionnaire comprised of 36 items, divided into 9 categories (A1 to A9), representing overall patient health: physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy / fatigue, emotional well-being, social functioning, pain, general health, and health change. Participants receive an overall score from 0 (worst health status) to 100 (best health status). Due to the aforementioned limitations of the BDD-SS, more than one measure of social function and health was necessary. We were most concerned with role limitations due to physical health (SF-36, A2), social functioning (SF-36, A6), and general health (SF-36, A8). However, all the results from the SF-36 are shown in the appendix. The SF-36 questionnaire has good validity and reliability, as a measure of role limitations due to physical function, social function, and general health, in cancer patients undergoing bilateral mastectomy and breast reconstruction with pre-pectoral implants.[94]

Procedure

From enrollment to program completion, outcome measures were collected every 2 weeks for a total of 12 weeks (total = 7 collections). Enrolled participants underwent baseline testing 10 days prior to surgery to evaluate upper limb function (DASH), pain interference (BPI), symptoms of neuropathic pain (LANSS), embodiment (BDD-SS, Avoidance Grouping), role limitations due to physical health (SF-36, A2), social functioning (SF-36, A6), and general health (SF-36, A8). Following the removal of surgical suction drains, 10 days post-operatively, participants completed the same pre-operative testing (DASH, BPI, LANSS, Avoidance Grouping, SF-36 A2, A6, A8).

Athletic Therapy Intervention

From the first post-operative appointment, and every following week, participants received 45-minutes of hands-on Athletic Therapy treatment as well as instructions for 4 functional reconditioning exercises to be done daily at home. For sensory nerve rehabilitation, participants were encouraged to engage with their chest on a daily basis, for 10 minutes at a time, using various kinds of touch (i.e., soft, deep, dragging fingernails across, walking fingers, tapping, someone else's hands) as well as textures and temperatures (i.e., hot, cold, smooth, rough). A more comprehensive overview of the care provided to participants during the first 6 weeks post-op is presented in the appendix.

Inclusive Environment

Individuals enrolled in this study received post-operative rehabilitative care in a clinical environment that was safe, inclusive, and queer. The space was selected for its proximity to public transport, its level entry access, and the availability of an elevator within the building. The clinic received plenty of natural light, was intentionally decorated with recognizable artworks by local queer artists, furnished with accessible seating, and contained a rotating selection of plants. This study signified its inclusivity by respecting pronouns, providing paperwork that demonstrated an understanding of gender / sex / orientation, and displaying visible rainbow / trans flags. Participants were addressed using their chosen name, which is the name that is commonly used and often differs from a legal first name. It is important to acknowledge that a “chosen” name is not just a preference but is the only name used and is essential to an individual’s identity.[95]

****Note:** the following photos were included in this document with the informed written consent of the participants and researcher shown.

Figure 1.

Figure 2.

Figure 3.

Figure 4.

Figures 1-4. The study was conducted in an inclusive clinical environment that received plenty of natural light and was decorated with artworks by local queer artists.

Statistical Analysis

A repeated-measures analysis of variance (ANOVA) using *SPSS* (IBM, v.29, Chicago, USA) was used to compare differences in upper limb function (DASH), pain interference (BPI), embodiment (BDD-SS, Avoidance Grouping), neuropathic pain (LANSS), role limitations due to physical health (SF-36, A2), social functioning (SF-36, A6), and general health (SF-36, A8) in the participants at four time points – pre-surgery, week 1, week 5, and week 11 post-operatively. Sphericity was tested in all cases using Mauchly's test and when significant, the Greenhouse-Geisser correction was applied. The DASH and BPI questionnaire scores were found significant using the ANOVA and were further analyzed using a Tukey HSD post-hoc comparison to identify which time points were statistically different.

Participants

Upon obtaining approval from the University Human Research Ethics Committee at Concordia University (Montréal, Canada), prospective participants were recruited through posters and curated posts on social media (@le.programme.top). In collaboration with the local gender surgery center, GrS Montréal, 54 emails were sent to eligible patients with information about the study. Forty-four (n = 44; Age = 30±6.1) participants met the inclusion criteria pre-operatively and were enrolled in the study. Informed written consent was obtained from each participant prior to the pre-surgery appointment. Two participants were lost to follow-up due to conflicts with the clinic schedule and the limited availability of the lead clinician. Forty-two participants (n = 42)

completed the full program, from pre-surgery enrollment to week 11 post-op.

Characteristics of the final participant cohort are shown in Table 1.

Table 1. Age and surgical characteristics of the 42 participants who met the pre-operative inclusion criteria, were enrolled, and completed all 12 pre- and post-operative weeks of the study.

	Total (n = 42)
Age	**n (%)**
18 - 24	8 (19)
25 - 34	22 (52)
35 - 44	12 (29)
Procedure	**n (%)**
Double-incision mastectomy	
with NAC* grafts	29 (69)
without NAC* grafts	8 (19)
*NAC = nipple areolar complex	
Periareolar	1 (2)
Keyhole	1 (2)
Inverted T, reduction	3 (7)

Results

Outcome Measures

Upper Limb Function – (DASH)

Table 2. Self-reported upper limb function as measured by the DASH questionnaire in 42 participants who underwent gender-affirming top surgery followed by 11 weeks of treatment.

Collection Point	Mean
Pre-Surgery	4.3 ± 7.0
Week 1	56.7 ± 14.8*
Week 5	23.0 ± 15.3*
Week 11	4.0 ± 5.5*

* - indicates the mean difference is significant at the 0.05 level.

Comparisons of pre- and post-operative DASH scores were made using a repeated-measures ANOVA, which violated sphericity assumptions ($p < 0.001$). The Greenhouse-Geisser correction was applied ($F = 296.0$; $df = 2.0$; $p < 0.001$) and a significant change in upper limb function was observed. A Tukey HSD post-hoc comparison identified a significant difference between all-time points except pre-surgery to week 11 post-op ($p < 0.001$). A statistically significant decrease in upper limb function was noted between pre-surgery and week 1 post-op. In addition, there was a statistically significant improvement in upper limb function between week 1 post-op and Week 5 post-op as well as week 5 post-op and week 11 post-op ($p < 0.001$). There was no significant difference between upper limb function pre-surgery to week 11 post-op which suggests that participants achieved their pre surgery level of upper limb function after completing the rehabilitation program. Figure 5 gives a visual overview of self-reported DASH scores at all 4 collection points.

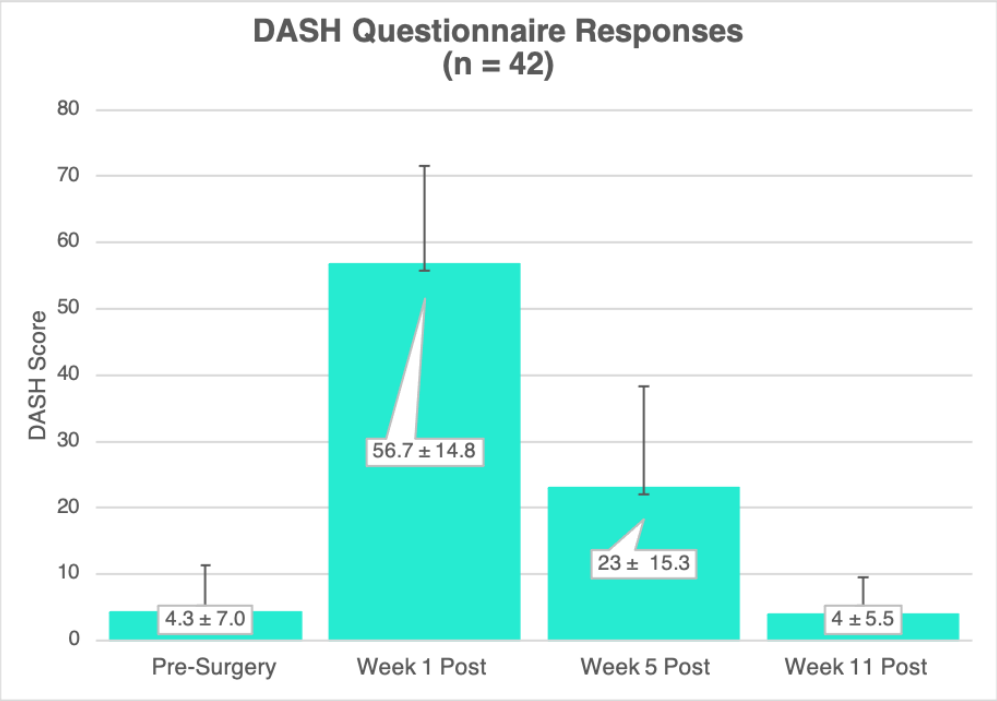

Figure 5. Self-reported upper limb function as measured by the DASH questionnaire in 42 participants who underwent gender-affirming top surgery, pre- as well as at weeks 1, 5, and 11 post-operatively.

Pain Interference – (BPI)

Table 3. Self-reported pain interference as measured by the BPI questionnaire in 42 participants who underwent gender-affirming top surgery followed by 11 weeks of treatment.

Collection Point	Mean
Pre-Surgery	0.8 ± 1.5
Week 1	3.8 ± 2.2*
Week 5	1.4 ± 1.9
Week 11	0.4 ± 0.9

* - indicates the mean difference is significant at the 0.05 level.

The repeated-measures ANOVA comparing pre- and post-operative BPI scores violated the assumptions of sphericity ($p = 0.005$). With the application of the Greenhouse-Geisser correction ($F = 61.6$; $df = 2.3$; $p < 0.001$), there was a significant difference in

pain interference during the course of the rehabilitation. The Tukey Post Hoc test indicated a statistically significant increase in pain interference between pre-surgery and week 1 post-op. In addition, there was a statistically significant decrease in pain interference between week 1 post-op and week 5 post-op as well as week 5 post-op and week 11 post-op.

Neuropathic Pain – (LANSS)

Table 4. Self-reported pain that is neuropathic in origin as measured by the LANSS questionnaire in 42 participants who underwent gender-affirming top surgery followed by 11 weeks of treatment.

Collection Point	Mean
Pre-Surgery	1.5 ± 3.0
Week 1	11.2 ± 5.3*
Week 5	6.2 ± 5.9
Week 11	4.0 ± 5.4

* - indicates the mean difference is significant at the 0.05 level.

When analysing scores from the LANSS questionnaire, the Mauchly's test of sphericity was not violated ($p = 0.819$) and with sphericity assumed, there was a significant difference in LANSS scores ($F = 40$; $df = 3$; $p < 0.001$). Participants reported an increase in neuropathic pain symptoms at weeks 1 and 5 post-op when compared to pre surgery. By week 11 post-op, participants were still reporting some neuropathic pain symptoms, more than on program enrolment (pre: 1.5 ± 3.0; week 11 post: 4.0 ± 5.4).

Embodiment – (BDD-SS, Avoidance Grouping)

Table 5. Self-reported embodiment as measured by the Avoidance Grouping of the BDD-SS questionnaire in 42 participants who underwent gender-affirming top surgery followed by 11 weeks of treatment.	
Collection Point	**Mean**
Pre-Surgery	2.9 ± 2.3*
Week 1	2.4 ± 1.7
Week 5	1.0 ± 1.7
Week 11	0.7 ± 1.6
* - indicates the mean difference is significant at the 0.05 level.	

A repeated-measures ANOVA comparing scores on the BDD-SS Avoidance Grouping did not violate sphericity ($p = 0.252$). With sphericity assumed, there was a significant difference in patient-reported embodiment ($F = 20.3$; $df = 3$; $p < 0.001$). Participants consistently reported avoiding more social and environmental experiences pre-op when compared to all post-op time points. Figures 6 through 9 present a more comprehensive overview of the Avoidance Grouping scores at all 4 collection points. In addition to the total overall Avoidance Grouping score, per item responses were also examined, as presented below in Figure 10. Because of the nature of the scale, per item responses are as important as the overall score, if not more so. For example, prior to surgery half of participants (n = 21, Figure 6) reported avoiding being seen nude or with few clothes (item #6) compared to only three (n = 3, Figure 9) by week 11 post-op which is a meaningful reduction. In addition, more than half of participants (n = 26, Figure 6) reported hiding their appearance (item #7) prior to surgery compared to only two (n = 2, Figure 7) at week 1 post-op, which is a remarkable change so soon after the operation. In Figure 7, there is an increase in week 1 post-op responses to items #2

(avoiding social situations; n = 20, 47.6%), #3 (avoiding public areas; n = 27, 64.3%), and #4 (avoiding close intimate contacts; n = 23, 54.8%) when compared to pre-op values, with nearly half of participants reporting avoiding each of these items. By weeks 5 (Figure 8) and 11 (Figure 9) post-op, very few participants reported avoiding these same 3 items: #2 (week 5: n = 3, 7.1%; week 11, n = 3, 7.1%), #3 (week 5: n = 7, 16.7%; week 11: n = 4, 9.5%) and #4 (week 5: n = 2, 4.8%; week 11: n = 4, 9.4%). By program completion at week 11 (Figure 9), zero participants (n = 0) reported avoiding physical activities like exercise or recreation because of concern about appearance.

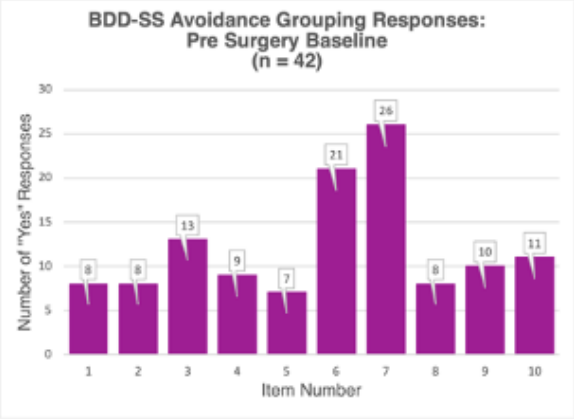

Figure 6. Self-reported embodiment as measured by the Avoidance Grouping of the BDD-SS questionnaire in 42 participants prior to undergoing gender-affirming top surgery.

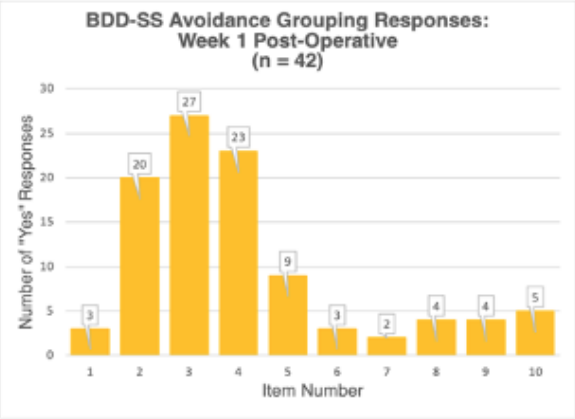

Figure 7. Self-reported embodiment as measured by the Avoidance Grouping of the BDD-SS questionnaire in 42 participants 1 week after undergoing gender-affirming top surgery.

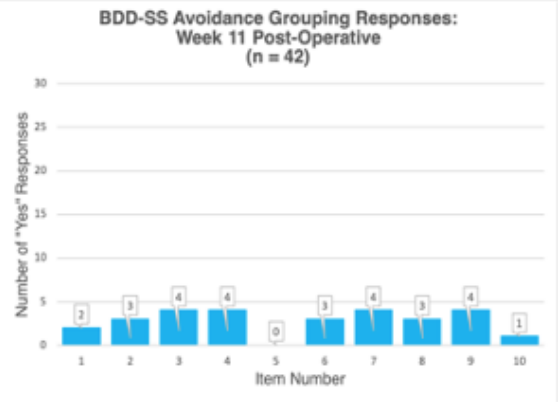

Figure 8. Self-reported embodiment as measured by the Avoidance Grouping of the BDD-SS questionnaire 5 weeks after receiving gender-affirming top surgery.

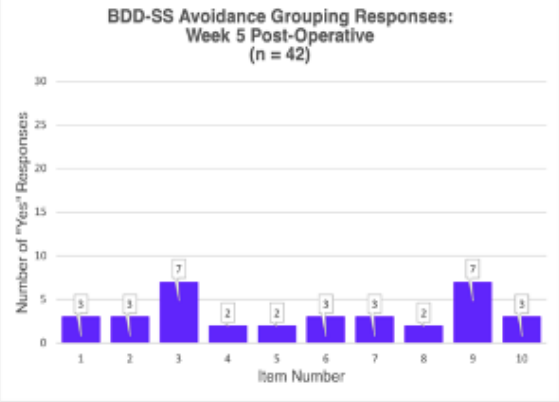

Figure 9. Self-reported embodiment as measured by the Avoidance Grouping of the BDD-SS questionnaire 11 weeks following gender-affirming top surgery.

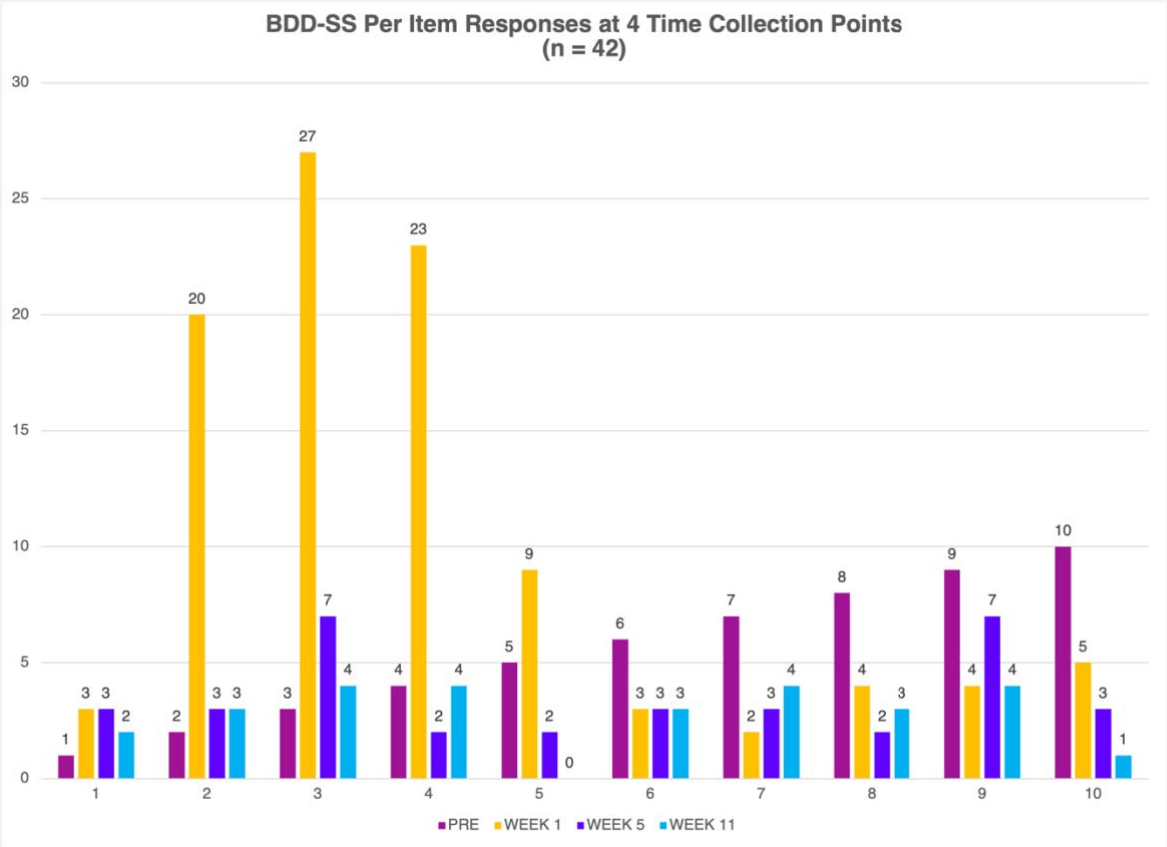

Figure 10. Self-reported embodiment as measured per item by the Avoidance Grouping of the BDD-SS questionnaire at 4 time points following gender-affirming top surgery.

Role Limitations due to Physical Health – (SF-36: A2)

Table 6. Self-reported role limitations due to physical health (SF-36 questionnaire, category A2) as measured in 42 participants who underwent gender-affirming top surgery followed by 11 weeks of treatment.

Collection Point	Mean
Pre-Surgery	74.4 ± 42.6
Week 1	7.7 ± 21.0*
Week 5	16.7 ± 33.0
Week 11	61.9 ± 41.0

* - indicates the mean difference is significant at the 0.05 level.

A comparison of SF-36 A2 scores using a repeated-measures ANOVA did not violate sphericity ($p = 0.616$). With sphericity assumed, there was significant difference in SF-36 A2 scores ($F = 42.1$; $df = 3$; $p < 0.001$). These scores represented an increase in role limitations due to physical health at weeks 1 and 5 post-op when compared to pre-surgery scores. By program completion at week 11 post-op, there was a decrease in role limitations due to physical health when compared to both week 1 and week 5 post-op.

Social Functioning – (SF-36: A6)

Table 7. Self-reported social functioning (SF-36 questionnaire, category A6) as measured in 42 participants who underwent gender-affirming top surgery followed by 11 weeks of treatment.

Collection Point	Mean
Pre-Surgery	75.6 ± 21.4
Week 1	44.6 ± 21.2
Week 5	63.4 ± 23.3
Week 11	81.5 ± 19.8*
* - indicates the mean difference is significant at the 0.05 level.	

Sphericity assumptions were not violated when comparing scores from the social functioning category (A6) of the SF-36 questionnaire, as analyzed with a repeated-measures ANOVA ($p = 0.609$). With sphericity assumed, there was significant difference in participant-reported SF-36, category A6 scores ($F = 28.5$; $df = 3$; $p < 0.001$). Following 11 weeks of study enrollment, participants reported a significant improvement in social functioning when compared to all other collection points.

General Health – (SF-36: A8)

Table 8. Self-reported general health as measured by the SF-36 questionnaire, category A8, in 42 participants who underwent gender-affirming top surgery followed by 11 weeks of treatment.	
Collection Point	**Mean**
Pre-Surgery	79.4 ± 20.1
Week 1	38.1 ± 23.7
Week 5	50.5 ± 22.3
Week 11	81.4 ± 19.9
* - indicates the mean difference is significant at the 0.05 level.	

Sphericity assumptions were violated when analysing SF-36 category A8 scores using a repeated-measures ANOVA ($p = 0.010$). With the Greenhouse-Geisser correction, there was no significant difference in general health ($F = 2.3$; $df = 2.5$; $p = 0.091$). Participants reported a decrease in general health at week 1 post-op when compared to pre-surgery values, which improved by week 5 post-op. Scores at week 11 post-op were improved when compared to all other collection points however, this difference was not significant.

Discussion

This study is the first that we know of to measure functional as well as psychological improvements, in a group of trans and gender diverse individuals, following gender-affirming top surgery. As stated above and due to various reasons, many individuals receive no aftercare following gender-affirming top surgery. The aim of this study was to highlight the necessity of post-operative rehabilitative care and how this care, provided in an inclusive environment, can significantly improve patient outcomes in individuals

receiving gender-affirming top surgery. Participants who received 11 weeks of post-operative rehabilitative care through enrollment in this study reported that consistently positive experiences in healthcare spaces, plus functional rehabilitative care, improved both functional and psychological outcomes following gender-affirming top surgery.

Upper Limb Function

All participants experienced a significant improvement in upper limb function over the course of the rehabilitation program. The disruption in upper limb function experienced by the participants after the gender-affirming top surgery was significant. A good comparison is a previous study that evaluated upper limb function, in another sample population, following a variety of shoulder surgery procedures (i.e., subacromial pain syndrome, rotator cuff rupture, instability, glenohumeral osteoarthritis, etc.) in 176 participants (n = 176) and reported pre-surgery mean DASH scores of 40.5 ± 20.9 with scores improving to 16.8 ± 17 by 12 months post-op.[96] Participants in our study reported being more limited at week 1 following gender-affirming top surgery than the elective surgery cohort did prior to undergoing surgery (n = 42, 56.7 ± 14.8 versus n = 176, 40.5 ± 20.9).[96] Following 11 weeks of post-operative rehabilitative care, our participants reported significantly improved upper limb function (week 11: 4.0 ± 5.5) compared to the upper limb function of the 176 participants at 12 months post-op (12-months: 16.8 ± 17).[96] Not only were our participants more severely limited immediately following surgery, they improved more during the 11 weeks of post-operative study enrollment than the elective surgery cohort did 12 months post-op. Additionally, the amount of improvement our participants reported using the DASH questionnaire was statistically

and clinically significant. A good comparison of upper limb function scores is with a previous study that examined 109 patients (n = 109) who underwent a variety of upper limb surgical interventions pre- as well as 6 to 21 months post-operatively. This comparative study found that a 10-point difference in mean DASH scores was the minimal important change.[97] Of note, participants in our study reported at least a 10-point difference at all post-operative time points demonstrating a significant statistical and clinical improvement in upper limb function at each collection point. Week 1 post-op our participants reported a mean DASH score of 56.7 ± 14.8, which represents a 52.4-point decrease in upper limb function when compared to pre-op values (pre: 4.3 ± 7.0). By week 5 post-op, participants were reporting a 33.7-point improvement in upper limb function (week 5: 23.0 ± 15.3) and by study completion at week 11 post-op, mean DASH scores continued to improve, by an additional 19-points (week 11: 4.0 ± 5.5). Given how limited our participants reported being 1 week after undergoing gender-affirming top surgery, improvements in upper limb function easily achieved the minimally important difference at weeks 5 and 11 post-operatively. The drastic improvement in the upper limb function, as self-reported by our participants, highlights the need for post-operative rehabilitative care in order to improve functional outcomes following top surgery.

Pain Interference

Pain did not interfere with the rehabilitation process following gender-affirming top surgery. The BPI questionnaire ranks interference due to pain from 0 (absence of pain or interference) to 10 (as bad as it can be) with a minimally important difference of 2 points.[98] Scores ranging from 1 to 4 are considered to represent mild pain interference, from 5 to 6 considered moderate, and from 7 to 10 representing severe interference.[98] The worst mean pain interference score reported by the 42 participants of this study was 1 week post-op (3.8 ± 2.2). By week 5 post-op, participants reported mean scores that achieved the 2-point minimally important difference when compared to week 1 post-op (week 1: 3.8 ± 2.2 versus week 5, 1.4 ± 1.9).[99] By program completion at 11 weeks, participant-reported pain interference scores were lower than pre-surgery scores by a half point (pre: 0.8 ± 1.5; week 11, 0.4 ± 0.9). The mean pain scores reported in this study show that top surgery procedures are mildly painful and that interference due to pain improves quickly with post-operative rehabilitative care.

Neuropathic Pain

We used a shortened version of the LANSS questionnaire in this study due to time restrictions, and still our participants came close to reporting the presence of pain with neuropathic features (i.e., total LANSS scores over 12) a week after undergoing top surgery. The full version of the LANSS self-report questionnaire consists of 7 items: 5 items to evaluate the presentation of pain during the last week, and 2 diagnostic items evaluating for allodynia and hyperalgesia with total scores ranging from 0 to 24. A score of 12 points or more on the 24-point LANSS questionnaire suggests the presence of

pain with neuropathic features.[90,100] The original plan for this study was to complete the full LANSS questionnaire, including the 2 diagnostic items, which would have given total scores on 24 points, instead of on 16 points. Since participants in this study were already completing 4 other questionnaires and due to the constraint on treatment time created by the entire battery of 5 tests, the diagnostic items of the LANSS questionnaire were not completed. The scores obtained on the abbreviated LANSS questionnaire used for this study were from 0 to 16 and as a result, these scores cannot be compared to those of other studies where the full scale was collected. It is recommended that future studies evaluate the diagnostic items in order to identify the presence of allodynia and hyperalgesia following surgery. Despite the invasive nature of top surgery, participants in this study reported a statistically significant difference in LANSS scores that was less than the 12-points needed to indicate the presence of neuropathic pain. Participants reported a significant increase in symptoms 1 week following surgery, with approximately half of participants reporting neuropathic pain symptoms (11.2 ± 5.3). Even on the shortened 16-point scale, week 1 post-op mean LANSS scores were not above 12 and therefore did not quantify the presence of neuropathic pain but were close. By week 5 post-op, participants were still reporting some neuropathic pain symptoms but improved when compared to week 1 post-op (week 1: 11.2 ± 5.3; week 5: 6.2 ± 5.9). During appointments, participants frequently reported altered sensation (i.e., numbness, muted sensation, pins / needles, zaps, hypersensitivity, achiness, etc.) in the chest wall, above and below incision lines as well as into the axilla, bilaterally. Altered sensation, specifically hypersensitivity, most frequently reported by participants 3 to 5 weeks post-op, presented a challenge during the hands-on treatment portion of

weekly appointments. Navigating soft tissue release of the chest wall was done while continually checking in with the participant, so as to not aggravate pain.

Embodiment

From week 1 post-op through to program completion at week 11, we maintain there was a clinically and statistically significant improvement in participant-reported embodiment. While both total and per item responses were considered when analysing responses to the Avoidance Grouping of the BDD-SS questionnaire, the changes in the per item responses were noteworthy and provided a more complete picture of what it is like emotionally to recover from gender-affirming top surgery as well as the impact the surgery has on quality of life. Pre-surgery total scores reflected that participants were, on average, avoiding about 3 environments, social experiences and or engaging in certain avoidant behaviors, compared to less than 1 by week 11 post-op. However, the change in total score from 2.9 to 0.7 on the Avoidance Grouping of the BDD-SS does not reflect the impact this would have on the quality of life in a person. A good example of this is the “hiding appearance” item. Prior to surgery, 62% of participants (n = 26) in this study reported yes to “hiding appearance” (BDD-SS Avoidance Grouping, item #7) compared to 9.5% (n = 4) by program end at week 11, representing a 52.5% decrease in participants who were hiding their appearance before surgery but were no longer doing so after surgery. Half of participants (n = 21) reported “avoiding being seen nude or with few clothes” (BDD-SS Avoidance Grouping, item #6) prior to surgery, compared to 7% (n = 3) by 1 week after surgery, indicating improved embodiment: participants were more comfortable in their bodies and more willing to engage with others than they

were before undergoing top surgery. Another interesting finding was the increase in some avoidant behaviours reported by participants 1 week after surgery. For example, the number of participants who endorsed items #2 (avoiding social situations) and #3 (avoiding public areas) prior to surgery more than doubled by week 1 post-op (#2: pre, n = 8 versus week 1 post, n = 20; #3: pre, n = 13 versus week 1 post, n = 27). The increased avoidance of these 2 items at week 1 post-op is typical of convalescing but likely also due in part to the pain and discomfort caused by surgical suction drains, which are generally present for the first 4 to 10 days following top surgery. As discussed earlier in the methods section, it was challenging to find the right scale to measure changes in embodiment following gender-affirming top surgery. We settled on using the Avoidance Grouping of the BDD-SS, which we acknowledge, is not what this scale was originally developed for. However, we are not the only research group that have used the Avoidance Grouping in a population who are not experiencing disordered eating. A previous study that was developing a new scale, the Body Image after Mastectomy Scale (BIMS), used 8 of the 10 items from Avoidance Grouping of the BDD-SS in the final version of this new questionnaire.[93] Forty-seven participants (n = 47) who underwent mastectomy with reconstruction completed the BIMS by self-report 3 months following surgery.[93] When comparing the per item results between the BIMS validation study and the current study, the impact of the rehabilitative aftercare received by our participants is apparent. By program end at 11 weeks, only 7% (n = 3) of our participants reported “avoiding being seen nude or with few clothes” (BDD-SS Avoidance Grouping, item #6) compared to 36.2% (n = 17) at 3 months post-op in the BIMS validation study.[93] Additionally, 9.5% (n = 4) of participants in the current study

reported “avoiding intimate or close physical contact with others” (BDD-SS Avoidance Grouping, item #4) compared to 27.7% (n = 13) in the BIMS study.[93] By program completion at week 11, no participants (n = 0) in our study reported “avoiding physical activities like exercise or recreation because of concern about appearance” (BDD-SS Avoidance Grouping, item #5) compared to 16.7% (n = 7) who reported doing so prior to surgery. Meanwhile, in the BIMS validation study, 14.7% of participants (n = 7) were still avoiding physical activity at 3 months post-op.[93] Based on the per item comparison between the BIMS validation study and the current study, our participants felt more comfortable and centered in their bodies at 11 weeks than the participants of the BIMS study did at 3 months post-op. This difference highlights that having been followed closely throughout the recovery process, with individualized rehabilitative aftercare, was to the benefit of our participants: they were avoiding less environments or social experiences and engaging less in certain avoidant behaviors by the end of their study enrolment.

Rehabilitation

The care provided within the scope of Athletic Therapy is, in general, highly individualized to the goals of each patient, through the lens of injury prevention as well as functional optimization of movement, in accordance with the movements that are accessible to the patient. As such, the plan in this study was for post-operative rehabilitative care to be tailormade in alignment with the goals of each participant. During the pre-surgery appointment, participants were prompted to discuss their post-op goals, as relating to both movement and aesthetics (i.e., what do you want your chest to

look like? What do you want to be able to do with your chest?). From there, hands-on treatment and the exercises to be done at home would be specific to the needs and goals of each participant. Despite the wide variability of post-op goals, it was noteworthy that in-session treatments and the exercises prescribed were very similar in all participants for the first 6 weeks post-op, as highlighted by the intervention overview table included in the appendix. This finding suggests it might be possible to create a standardized rehabilitation protocol following gender-affirming top surgery. A post-operative protocol could potentially be developed for other qualified providers to use when providing care to patients following top surgery, and its efficacy could be measured. In cases where participants underwent chest tissue reduction, and in the absence of surgical suction drains, movement was regained more quickly than in mastectomy cases where drains were present. An aim for future studies should be to refine a gold-standard protocol for rehabilitative care following gender-affirming top surgery. Additionally, it was remarkable how at ease and comfortable participants were during weekly appointments which highlights the importance of patients feeling seen, accepted, and supported in healthcare spaces. The amount of gratitude expressed by participants, for having the opportunity to enrol in a queer-led study, to be closely followed throughout the rehabilitative process, and to be provided with consistently positive experiences in healthcare, was overwhelming. Many expressed that participation in the study had a positive impact on their post-operative outcomes and helped them feel less alone when navigating the post-op timeline.

SF-36: A2 - Role Limitations Due to Physical Health

At 1-week post-op, participants reported that undergoing top surgery caused a severe increase in role limitations due to physical health, as self-reported by the SF-36, category A2. While this result is similar to the disruption of upper limb function reported using the DASH questionnaire 1-week post-op, category A2 of the SF-36 examined physical health more broadly and considered how undergoing top surgery limited the day-to-day life role of each participant. Category A2 is scored on a 100-point scale with higher scores representing less role limitations due to physical health. The minimal clinically important difference on the physical component summary of the SF-36 questionnaire, including category A2, is 5 points with improvements of less than this value unlikely to be perceived by the participant.[101] Our participants reported severe limitations to role function due to physical health at week 1 post-op when compared to prior to surgery (pre: 74.4 ± 42.6 versus week 1 post: 7.7 ± 21.0). Role functioning due to physical health improved by almost twice the 5-point minimal clinically important difference by week 5 (16.7 ± 33.) By program end, at week 11 post-op, participants reported a decrease in role limitations due to physical health of 45 points but did not achieve pre-op values (week 11 post: 61.9 ± 41.0 versus pre: 74.4 ± 42.6). A possible explanation for our participants not achieving pre-op category A2 values by week 11 post-op could be that individuals were still settling into the routine of their usual work, social, and physical activities.

SF-36: A6 - Social Functioning

Following 11 weeks of post-operative rehabilitative care, participants in this study reported increased levels of social functioning when compared to all other data collection points. Social functioning was measured on a 100-point scale with higher scores representing better overall function. The minimal clinically important difference on the mental component summary of the SF-36 questionnaire is 5-points with improvements of less than this value unlikely to be perceived by the participant.[101] The minimal clinically important difference in social functioning was observed at all post-op collection points. Immediately following surgery and during the first week post-op, a significant decrease in social functioning was observed (week 1: 44.6 ± 21.2). Most participants reported staying close to home, taking short walks, napping, all while receiving few visitors, as is typical during convalescence. By week 5 post-op, the participants showed significant improvement, with A6 scores increasing by nearly 4 times the minimal clinically important difference (63.4 ± 23.3). At the end of the program, participants reported social functioning values that were better than pre-operative values, again with values that achieved the minimal clinically important difference (pre: 75.6 ± 21.4 versus week 11: 81.5 ± 19.8). Similar to the aforementioned improvement in embodiment, the improved social functioning experienced by our participants by the end of the program highlights that they felt more at ease in their bodies, allowing them to engage more comfortably in social interactions.

SF-36: A8 - General Health

There was no change in the general health of participants from before to 11 weeks following gender-affirming top surgery. There are 5 items that make up category A8 on the SF-36 questionnaire, which represents general health. These items assess current health status, expectations of health change, and make comparisons to the general health of other people. Despite pre and week 11 post-op values being comparable, the difference was not significant (pre: 79.4 ± 20.1 versus week 11: 81.4 ± 19.9). While top surgery is a major and invasive procedure, following 11 weeks of functional rehabilitative care in an inclusive and welcoming clinical environment, most participants had returned to their usual levels of physical and social activities. Feeling supported throughout the post-op process meant that the period of recovery was not disruptive to the general health of the participants.

Conclusion

Top surgery is an important and affirming procedure for trans and gender diverse individuals. During the first post-operative week, individuals experience severe functional limitations involving the upper extremity, a disruption to their usual day-to-day routines, as well as a decreased desire to be social and engage with the world. These physical and psychological interruptions persist until 11 weeks post-op, which means that individuals undergoing gender-affirming top surgery would benefit from unobstructed access to consistent aftercare and support during convalescence. As an additive effect of receiving care in a positive and affirming clinical environment, participants in our study experienced improved physical and psychological outcomes,

often reporting outcomes that were better than they were prior to undergoing top surgery. Despite the uniqueness of each individual's surgical experience and the variability of their post-operative goals, participants of this study were provided with almost the same rehabilitative intervention (i.e., hands-on treatment and functional exercises) for the first 6 weeks following surgery. This means it would be feasible to develop a standardized rehabilitative and manual therapy protocol to support patients recovering from top surgery, ensuring a consistent treatment plan for any individual following gender-affirming top surgery. Future studies should explore the establishment of such a protocol.

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Appendix

i. Athletic Therapy Intervention

Athletic Therapy Intervention Following Gender-Affirming Top Surgery, Weeks 1 to 6 Post-Op

Time Post-Op →	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Muscles Addressed (Soft Tissue Release)	Scalene group Supraspinatus Trapezius - Up / Mid Subclavious Levator Scapulae Serratus Posterior Sup. SCM Splenius Capitis Ant Deltoid Pec Minor Biceps Forearm Flexors	Scalene group Supraspinatus Trapezius - Up / Mid Subclavious Levator Scapulae Serratus Posterior Sup. SCM Splenius Capitis Ant Deltoid Pec Minor Pec Major Teres group Subscapularis	Supraspinatus Trapezius - Up / Mid Subclavious Levator Scapulae Serratus Posterior Sup. SCM Deltoid group Pec Minor Pec Major Teres group Subscapularis	Supraspinatus Subclavious Levator Scapulae Serratus Posterior Sup. Deltoid group Pec Minor Pec Major Teres group Subscapularis Latissimus Dorsi Infraspinatus Rhomboids Trapezius - Mid / Low	Supraspinatus Subclavious Levator Scapulae Serratus Posterior Sup. Deltoid group Pec Minor Pec Major Teres group Subscapularis Latissimus Dorsi Infraspinatus Rhomboids Trapezius - Mid / Low	Supraspinatus Subclavious Levator Scapulae Serratus Posterior Sup. Deltoid group Pec Minor Pec Major Teres group Subscapularis Latissimus Dorsi Infraspinatus Rhomboids Trapezius - Mid / Low
Home Exercise Program **(HEP)** (Exercises / Stretches) **as tolerated, pain-free no scar-line tug discomfort OK**	Scapular Mobility (CARs) C/Spine Self-Release Circulatory Reboot Supine Belly Breathing	Palms Up SHD External Rotation Wall Angels / Hand Flips C/Spine Self-Release 360 Low Rib Breathing (seated)	Wall Angels → as tolerated, 45 to 80-degrees Palms Up ER + Elastic Wall Push for Serratus Ant. 360 Low Rib Breathing (seated)	Wall Angels → to 90-degrees Wall Crawls Cactus Arm Raises 4-pattes Push	Wall Angels → to just before scar pull Intro Serratus Saw Baby Cobra BW Pec Flies	Wall Angels → to just before scar pull or Ws if FROM 4-pattes T/Spine Rotation Modified Push-Up Chickpea Pec Flies / Chest Press
Sensory Nerve Rehab **including entire chest manubrium > clavicles axilla > low ribs > xiphoid bilaterally**	<u>Touch</u> - walk fingers - drag nails - sustained light pressure - sustained deep pressure - someone else's hand	<u>Touch</u> - walk fingers - drag nails - sustained light pressure - sustained deep pressure - someone else's hand	<u>Touch + Temperature</u> - hot - cold	<u>Touch + Temperature</u> - hot - cold	<u>Touch + Texture + Temperature</u> - smooth - rough	<u>Touch + Texture + Temperature</u> - smooth - rough
Self / Scar Massage **as tolerated, pain-free discomfort OK**	<u>Skin Swiping</u> - towards axilla bilaterally	<u>Skin Swiping</u> - towards axilla bilaterally	<u>Skin Swirling</u> - above / below incision lines - 3 fingers, superficial contact - bilaterally	<u>Skin Swirling</u> - above / below incision lines - 3 fingers, superficial contact - bilaterally	<u>Scar Massage</u> - direct contact, 1 finger - circles / zigzags / following line - bilaterally	<u>Scar Massage</u> - direct contact, 1 finger - broad contact, 3 fingers - circles / zigzags / following line - bilaterally
(Aim) (Time Recommended)	(lymphatic drainage) 2 minutes per side	(lymphatic drainage) 2 minutes per side	(skin mobility / movement) 3 minutes per side	(skin mobility / movement) 3 minutes per side	(scar mobility / remediation) 3 minutes per side	(scar mobility / adhesion breakdown) 5 minutes per side

ii. DASH – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx DASH total	4.2659	7.0379	42
Week1 DASH total	56.7063	14.8126	42
Week5 DASH total	23.0159	15.2752	42
Week11 DASH total	4.0278	5.4565	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.362	40.387	5	<.001	.676	.712	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	77408.631	3	25802.877	295.958	<.001	.878
	Greenhouse-Geisser	77408.631	2.029	38148.121	295.958	<.001	.878
	Huynh-Feldt	77408.631	2.136	36247.401	295.958	<.001	.878
	Lower-bound	77408.631	1.000	77408.631	295.958	<.001	.878
Error (Time)	Sphericity Assumed	10723.661	123	87.184			
	Greenhouse-Geisser	10723.661	83.196	128.897			
	Huynh-Feldt	10723.661	87.558	122.475			
	Lower-bound	10723.661	41.000	261.553			

F-Value

Analysis of Variance to Test *H0: μ1 = μ 2 =μ3 = μ4*

Means:

- Pre-Sx DASH: $\bar{y}_1$= 4.27
- Week 1 DASH: $\bar{y}_2$= 56.71
- Week 5 DASH: $\bar{y}_3$= 23.02
- Week 11 DASH: $\bar{y}_4$= 4.03

Type III Sum of Squares for Time: SS_{Time} = 77408.631

Degrees of Freedom for Time: df_{Time}= 2.029 (adjusted by Greenhouse-Geisser)

Mean Square for Time: $MS_{Time} = SS_{Time} / df_{Time}$ = 77408.631/ 2.029 = 38148.121

Error Sum of Squares: SS_{Error} = 10723.661

Degrees of Freedom for Error: df_{Error} = 83.196 (adjusted by Greenhouse-Geisser)

Mean Square for Error: $MS_{Error} = SS_{Error} / df_{Error}$ = 10723.661/ 83.196 = 128.897

F-Value: $F = MS_{Time} / MS_{Error}$ = 38148.121 / 128.897 = 295.96

Tukey HSD Post-Hoc

Mean Squares for Error: MS_{Error} = 128.897

Number of Samples: n = 42

Critical q-value: From the studentized range distribution table with df_{Error} = 83.196 and 4 time points, q ≈ 3.708 (for α = 0.05).

Standard Error (SE) of Differences: SE = $\sqrt{\frac{\text{MSError}}{n}} = \sqrt{\frac{128.897}{42}} = 1.752$

Minimum Significant Difference (MSD): $MSD = (q_{crit})(SE)$ = (3.708)(1.752) = 6.49

Pairwise Comparisons

Pre-Sx vs. Week 1: |4.27−56.71| = 52.44

Pre-Sx vs. Week 5: |4.27−23.02| = 18.75

Pre-Sx vs. Week 11: |4.27−4.03| = 0.24

Week 1 vs. Week 5: |56.71−23.02| = 33.69

Week 1 vs. Week 11: |56.71−4.03| = 52.68

Week 5 vs. Week 11: |23.02−4.03| = 18.99

Compare each difference with the MSD = 6.49

iii. BPI – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx BPI 9 total	.7959	1.52534	42
Week1 BPI 9 total	3.7755	2.19442	42
Week5 BPI 9 total	1.3980	1.90217	42
Week11 BPI 9 total	.3776	.89009	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.655	16.795	5	.005	.765	.813	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	290.383	3	96.794	61.595	<.001	.600
	Greenhouse-Geisser	290.383	2.295	126.514	61.595	<.001	.600
	Huynh-Feldt	290.383	2.439	119.058	61.595	<.001	.600
	Lower-bound	290.383	1.000	290.383	61.595	<.001	.600
Error (Time)	Sphericity Assumed	193.290	123	1.571			
	Greenhouse-Geisser	193.290	94.106	2.054			
	Huynh-Feldt	193.290	99.999	1.933			
	Lower-bound	193.290	41.000	4.714			

F-Value

Degrees of Freedom for Time: $df_{Time} = 2.295$ (adjusted by Greenhouse-Geisser)

Degrees of Freedom for Error: $df_{Error} = 94.106$ (adjusted by Greenhouse-Geisser)

F-Value: 61.595

Tukey HSD Post-Hoc

Mean Squares: MS_{Error}= 2.054

Number of Samples: n = 42

Critical q-value: From the studentized range distribution table with df_{Error} = 94.106 and 4 time points, q ≈ 3.699 (for α = 0.05).

Standard Error (SE) of Differences: SE = $\sqrt{\frac{\text{MSError}}{n}} = \sqrt{\frac{2.054}{42}} = 0.221$

Minimum Significant Difference (MSD): MSD = (q_{crit})(SE) = (3.699)(0.221) = 0.818

Pairwise Comparisons

Pre-Sx vs. Week 1: |0.796−3.776| = 2.980

Pre-Sx vs. Week 5: |0.796−1.398| = 0.602

Pre-Sx vs. Week 11: |0.796−0.378| = 0.418

Week 1 vs. Week 5: |3.776−1.398| = 2.378

Week 1 vs. Week 11: |3.776−0.378| = 3.398

Week 5 vs. Week 11: |1.398−0.378| = 1.020

Compare each difference to the MSD = 0.818

iv. BDD-SS, Avoidance Grouping – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx BDSStotal	2.8810	2.29743	42
Week1 BDSStotal	2.3810	1.65208	42
Week5 BDSStotal	1.0238	1.71774	42
Week11 BDSStotal	.6667	1.55652	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.847	6.601	5	.252	.893	.961	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	141.857	3	47.286	20.326	<.001	.331
	Greenhouse-Geisser	141.857	2.679	52.953	20.326	<.001	.331
	Huynh-Feldt	141.857	2.884	49.189	20.326	<.001	.331
	Lower-bound	141.857	1.000	141.857	20.326	<.001	.331
Error (Time)	Sphericity Assumed	286.143	123	2.326			
	Greenhouse-Geisser	286.143	109.837	2.605			
	Huynh-Feldt	286.143	118.242	2.420			
	Lower-bound	286.143	41.000	6.979			

v. LANSS – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx LANSS total	1.5000	2.96525	42
Week1 LANSS total	11.1667	5.32787	42
Week5 LANSS total	6.1905	5.87362	42
Week11 LANSS total	3.9762	5.42122	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.946	2.212	5	.819	.968	1.000	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	2130.923	3	710.308	40.209	<.001	.495
	Greenhouse-Geisser	2130.923	2.903	734.010	40.209	<.001	.495
	Huynh-Feldt	2130.923	3.000	710.308	40.209	<.001	.495
	Lower-bound	2130.923	1.000	2130.923	40.209	<.001	.495
Error (Time)	Sphericity Assumed	2172.827	123	17.665			
	Greenhouse-Geisser	2172.827	119.028	18.255			
	Huynh-Feldt	2172.827	123.000	17.665			
	Lower-bound	2172.827	41.000	52.996			

vi. SF-36 A1: Physical Functioning – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx SF36 A1	92.8571	13.02637	42
Week1 SF36 A1	46.0714	20.10751	42
Week5 SF36 A1	74.6429	18.22598	42
Week11 SF36 A1	91.1905	18.00439	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.715	13.311	5	.021	.817	.873	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	59317.857	3	19772.619	78.057	<.001	.656
	Greenhouse-Geisser	59317.857	2.452	24188.724	78.057	<.001	.656
	Huynh-Feldt	59317.857	2.620	22640.101	78.057	<.001	.656
	Lower-bound	59317.857	1.000	59317.857	78.057	<.001	.656
Error (Time)	Sphericity Assumed	31157.143	123	253.310			
	Greenhouse-Geisser	31157.143	100.544	309.886			
	Huynh-Feldt	31157.143	107.421	290.046			
	Lower-bound	31157.143	41.000	759.930			

Result: Sphericity assumptions were violated (p = 0.021). With the application of the Greenhouse-Geisser correction, there was a significant difference in SF-36 category A1 scores (F = 78.1; df = 2.5; p < .001).

vii. SF-36 A2: Role Limitations due to Physical Health – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx SF36 A2	74.4048	42.58710	42
Week1 SF36 A2	7.7381	21.01690	42
Week5 SF36 A2	16.6667	32.97572	42
Week11 SF36 A2	61.9048	41.03764	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.915	3.548	5	.616	.944	1.000	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	136443.452	3	45481.151	42.083	<.001	.507
	Greenhouse-Geisser	136443.452	2.831	48189.725	42.083	<.001	.507
	Huynh-Feldt	136443.452	3.000	45481.151	42.083	<.001	.507
	Lower-bound	136443.452	1.000	136443.452	42.083	<.001	.507
Error (Time)	Sphericity Assumed	132931.548	123	1080.744			
	Greenhouse-Geisser	132931.548	116.087	1145.107			
	Huynh-Feldt	132931.548	123.000	1080.744			
	Lower-bound	132931.548	41.000	3242.233			

viii. SF-36 A3: Role Limitations / Emotional Problems – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx SF36 A3	50.7935	43.70271	42
Week1 SF36 A3	51.5872	45.50372	42
Week5 SF36 A3	63.4920	45.26918	42
Week11 SF36 A3	67.4603	41.31191	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.890	4.626	5	.463	.935	1.000	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	8915.402	3	2971.801	2.632	.053	.060
	Greenhouse-Geisser	8915.402	2.806	3177.308	2.632	.057	.060
	Huynh-Feldt	8915.402	3.000	2971.801	2.632	.053	.060
	Lower-bound	8915.402	1.000	8915.402	2.632	.112	.060
Error (Time)	Sphericity Assumed	138862.587	123	1128.964			
	Greenhouse-Geisser	138862.587	115.044	1207.035			
	Huynh-Feldt	138862.587	123.000	1128.964			
	Lower-bound	138862.587	41.000	3386.892			

Result: Sphericity assumptions were not violated when analyzing SF-36, category A3 scores (p = 0.463). With sphericity assumed, there was no significant difference in role limitations due to emotional problems (F = 2.6; df = 3; p = 0.0530).

ix. SF-36 A4: Energy / Fatigue – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx SF36 A4	48.9286	15.90888	42
Week1 SF36 A4	39.7619	13.56791	42
Week5 SF36 A4	48.4524	18.32924	42
Week11 SF36 A4	52.5000	18.35457	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.742	11.860	5	.037	.866	.929	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	3687.351	3	1229.117	9.138	<.001	.182
	Greenhouse-Geisser	3687.351	2.597	1419.714	9.138	<.001	.182
	Huynh-Feldt	3687.351	2.788	1322.362	9.138	<.001	.182
	Lower-bound	3687.351	1.000	3687.351	9.138	.004	.182
Error (Time)	Sphericity Assumed	16543.899	123	134.503			
	Greenhouse-Geisser	16543.899	106.487	155.360			
	Huynh-Feldt	16543.899	114.327	144.707			
	Lower-bound	16543.899	41.000	403.510			

Result: Sphericity assumptions were violated when analyzing SF-36, category A4 scores ($p = 0.037$). The Greenhouse-Geisser correction was applied; there was a significant difference in participant energy and fatigue ($F = 9.1$; $df = 2.3$; $p < 0.001$).

x. SF-36 A5: Emotional Well-Being – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx SF36 A5	60.3810	14.04688	42
Week1 SF36 A5	60.0476	14.27594	42
Week5 SF36 A5	66.1905	17.42893	42
Week11 SF36 A5	66.4762	16.09611	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.649	17.159	5	.004	.765	.813	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	1576.643	3	525.548	4.016	.009	.089
	Greenhouse-Geisser	1576.643	2.294	687.239	4.016	.017	.089
	Huynh-Feldt	1576.643	2.438	646.762	4.016	.015	.089
	Lower-bound	1576.643	1.000	1576.643	4.016	.052	.089
Error (Time)	Sphericity Assumed	16094.357	123	130.848			
	Greenhouse-Geisser	16094.357	94.061	171.106			
	Huynh-Feldt	16094.357	99.948	161.028			
	Lower-bound	16094.357	41.000	392.545			

Result: Sphericity assumptions were violated (p = 0.004). The Greenhouse-Geisser correction was applied and therefore there was a significant difference in SF-36, category A5 scores (F = 4.0; df =2.3; p = 0.017).

xi. SF-36 A6: Social Functioning – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx SF36 A6	75.5952	21.37649	42
Week1 SF36 A6	44.6429	21.23167	42
Week5 SF36 A6	63.3929	23.32708	42
Week11 SF36 A6	81.5476	19.76194	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.913	3.594	5	.609	.948	1.000	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	33447.731	3	11149.244	28.479	<.001	.410
	Greenhouse-Geisser	33447.731	2.843	11765.771	28.479	<.001	.410
	Huynh-Feldt	33447.731	3.000	11149.244	28.479	<.001	.410
	Lower-bound	33447.731	1.000	33447.731	28.479	<.001	.410
Error (Time)	Sphericity Assumed	48153.832	123	391.495			
	Greenhouse-Geisser	48153.832	116.555	413.143			
	Huynh-Feldt	48153.832	123.000	391.495			
	Lower-bound	48153.832	41.000	1174.484			

xii. SF-36 A7: Pain – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx SF36 A7	79.4048	20.10498	42
Week1 SF36 A7	38.0952	23.70300	42
Week5 SF36 A7	50.5357	22.26185	42
Week11 SF36 A7	81.4286	19.94767	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.692	14.599	5	.012	.797	.850	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	58074.516	3	19358.172	64.809	<.001	.613
	Greenhouse-Geisser	58074.516	2.392	24278.023	64.809	<.001	.613
	Huynh-Feldt	58074.516	2.550	22770.544	64.809	<.001	.613
	Lower-bound	58074.516	1.000	58074.516	64.809	<.001	.613
Error (Time)	Sphericity Assumed	36739.546	123	298.695			
	Greenhouse-Geisser	36739.546	98.075	374.609			
	Huynh-Feldt	36739.546	104.567	351.348			
	Lower-bound	36739.546	41.000	896.086			

Result: Sphericity assumptions were violated (p = 0.012). Following the application of the Greenhouse-Geisser correction, a significant difference in category A7 scores was observed (f = 64.8; df = 2.4; p < .001).

xiii. SF-36 A8: General Health – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx SF36 A8	70.4762	22.05341	42
Week1 SF36 A8	67.2619	19.91452	42
Week5 SF36 A8	67.8571	20.42663	42
Week11 SF36 A8	70.9524	20.78455	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.684	15.060	5	.010	.835	.894	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	430.208	3	143.403	2.321	.079	.054
	Greenhouse-Geisser	430.208	2.506	171.661	2.321	.091	.054
	Huynh-Feldt	430.208	2.682	160.378	2.321	.086	.054
	Lower-bound	430.208	1.000	430.208	2.321	.135	.054
Error (Time)	Sphericity Assumed	7601.042	123	61.797			
	Greenhouse-Geisser	7601.042	102.752	73.975			
	Huynh-Feldt	7601.042	109.981	69.112			
	Lower-bound	7601.042	41.000	185.391			

xiv. SF-36 A9: Health Change – Repeated-Measures ANOVA

Descriptive Statistics

	Mean	Std. Deviation	N
Pre-Sx SF36 A9	64.8810	23.46477	42
Week1 SF36 A9	55.3571	27.90211	42
Week5 SF36 A9	54.1667	24.01515	42
Week11 SF36 A9	61.9048	21.55403	42

Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	.839	6.972	5	.223	.895	.963	.333

Tests of Within-Subjects Effects

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	3344.494	3	1114.831	4.227	.007	.093
	Greenhouse-Geisser	3344.494	2.685	1245.849	4.227	.009	.093
	Huynh-Feldt	3344.494	2.890	1157.080	4.227	.008	.093
	Lower-bound	3344.494	1.000	3344.494	4.227	.046	.093
Error (Time)	Sphericity Assumed	32436.756	123	263.713			
	Greenhouse-Geisser	32436.756	110.065	294.706			
	Huynh-Feldt	32436.756	118.509	273.707			
	Lower-bound	32436.756	41.000	791.140			

Result: Sphericity assumptions were not violated (p = 0.223). With sphericity assumed, there was a significant difference in SF-36 category A9 scores (F = 4.2; df = 3; p = .007).