

Usage and Clinical Perspectives of Silicone Oil as a Therapeutic Adjunct in Hand Rehabilitation: A Survey of New Zealand and Australian Therapists

Gail Donaldson *DipPhy, MPhy*

Centre for Health, Activity, and Rehabilitation Research, School of Physiotherapy, University of Otago, Dunedin, New Zealand

Gillian M. Johnson *MSc, PhD, FNZCP*

Centre for Health, Activity, and Rehabilitation Research, School of Physiotherapy, University of Otago, Dunedin, New Zealand

Gisela Sole *BSc(Physio), MSc(Med), PhD, FNZCP*

Centre for Health, Activity, and Rehabilitation Research, School of Physiotherapy, University of Otago, Dunedin, New Zealand

Meredith Perry *BPhy, MManipTh, PhD*

Centre for Health, Activity, and Rehabilitation Research, School of Physiotherapy, University of Otago, Wellington, New Zealand

ABSTRACT

This study aimed to quantify current silicone oil usage by therapists in New Zealand and Australia, and gauge clinician perceptions regarding the therapeutic properties of silicone oil. To ascertain clinical beliefs, a questionnaire containing Likert scales was custom designed. Therapists attending a combined hand conference held in Melbourne, Australia, in 2013 were surveyed, with a 50.4% response rate. One-quarter of therapists surveyed ($n = 126$) reported current usage of silicone oil. Therapists' perceptions were that silicone oil impacted positively on wound healing (Likert scale agreement score, 4.6/5) and finger movement, with less pain reported (Likert scale agreement score, 3.8/5). Silicone oil was used specifically after Dupuytren's palmar contracture release surgery. Non-use of silicone oil was mainly attributable to unavailability in the clinical setting. Results indicate that silicone oil is currently used and valued due to its pain-relieving and movement-promoting properties in combination with facilitation of wound healing.

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Key Words: Hand, Pain, Physical Therapy, Silicone Oil, Wound Healing

INTRODUCTION

The hand, by virtue of its functional interaction with the environment, frequently sustains trauma that disrupts the integrity of the skin (Kwan et al., 2009). Traumatic hand injuries, such as burns, lacerations, and abrasions, are common and frequently require acute medical interventions and ongoing care to achieve wound healing (Lazarus et al., 1994). Substantial wounds of the hand are often challenging to manage, as the multiple joints, and underlying tissues and tendons require controlled motion during healing to prevent the formations of unwanted adhesions (Merritt, 1998). Concurrently, the outer surface of the hand needs to re-establish skin integrity as the wound closes, but still have sufficient laxity to allow all joints full motion (Yang et al., 2014).

Since the 1960s, medical grade silicone oil (SiO) has been proposed as a therapeutic adjunct for open hand wounds, burns, and post-operative hand rehabilitation (Helal et al., 1982; Spira et al., 1967). Medical grade SiO is clear and odourless, with a viscosity of 350 centistokes (cS), which is similar to olive oil. In comparison water, has a viscosity of 1 cS at 20°C (Braley, 1970).

Anecdotal evidence suggests that SiO encourages early gains in finger motion with less associated pain (Helal et al., 1982; Spira et al., 1967) and increases the speed of wound healing, i.e., time taken to complete epithelisation (Weeder et al., 1967). Laboratory-based research has shown that SiO has antimicrobial properties, particularly against staphylococcal pathogens (Arici et al., 2016; Chrapek et al., 2012; Ozdamar et al., 1999). However, there is limited clinical research relating directly to hand wounds.

Despite historical case studies detailing the use of SiO for hand injuries (Helal et al., 1982; Maciejczyk, 1961; Spira et al., 1967; Weeder et al., 1967) and more recent ophthalmic studies (Dave et al., 2019), there has been no literature published during the last 18 years detailing the use of SiO in hand rehabilitation. In Australasia there are anecdotal reports of hand therapists using SiO, but it is unclear whether therapists regularly use SiO as an adjunct in hand rehabilitation. The purpose of this paper was to clarify SiO use in New Zealand and Australia and, if used, to gauge clinician's perceptions about its properties and effectiveness.

METHODS

This study is survey based, using a custom-designed questionnaire. A schematic overview of the study design is provided in Figure 1.

Questionnaire development

The University of Otago Human Ethics Committee granted ethical approval for this study (reference number D13/346). The questionnaire development included an initial literature search, an interview with two hand therapists, and a pilot test, from which five initial questions were identified:

1. Is SiO acceptable as an adjunct for open wound rehabilitation?
2. Are there adverse effects or risks associated with SiO usage?
3. What is the possible impact of SiO on pain experienced during exercise?
4. What impact does SiO have on finger range of motion?
5. What perceptions do therapists have regarding infection and wound healing with SiO usage?

The primary author (GD) conducted focus interviews with two hand therapists experienced in SiO use to gauge their opinion regarding the utility and overall scope of the questionnaire. Following these interviews, the cost of SiO and the impact on wound dressing changes were included in the questionnaire. Pilot testing on a convenience sample of five hand therapists during a regional hand therapy meeting determined minor formatting changes required to improve the questionnaire's clarity.

The silicone oil questionnaire

The final version of the questionnaire, entitled "The Silicone Oil in Hand Rehabilitation Questionnaire" (SiOQ) (Appendix A), contained 18 questions. Questions 1 to 6 entailed respondents'

professional demographic and professional registration status data. Question 7 asked whether the respondent used SiO, followed by two open-ended questions asking therapists' reasons for using or not using SiO. Questions 10 to 16 were completed by users of SiO to examine professional viewpoints of SiO use relating to finger range of motion, pain levels, impact on dressing changes, adverse effects, and risks of infection. Respondents rated their agreement with the statements on a 5-point Likert scale, which was anchored by the reference points "disagree", "unsure" (centred), and "agree". Finally, questions 17 and 18 were open-ended and related to therapists' perceptions of the benefits and disadvantages of SiO.

Administration of the SiOQ

To qualify for inclusion in the SiOQ, participants had to be a hand therapist registered with either a New Zealand or Australian parent body; had to be an attendee at the combined conference of Hand Therapy New Zealand (HTNZ) and the Australian Hand Therapy Association (AHTA) that was held in Melbourne, Australia in October 2013; and had to provide formal consent.

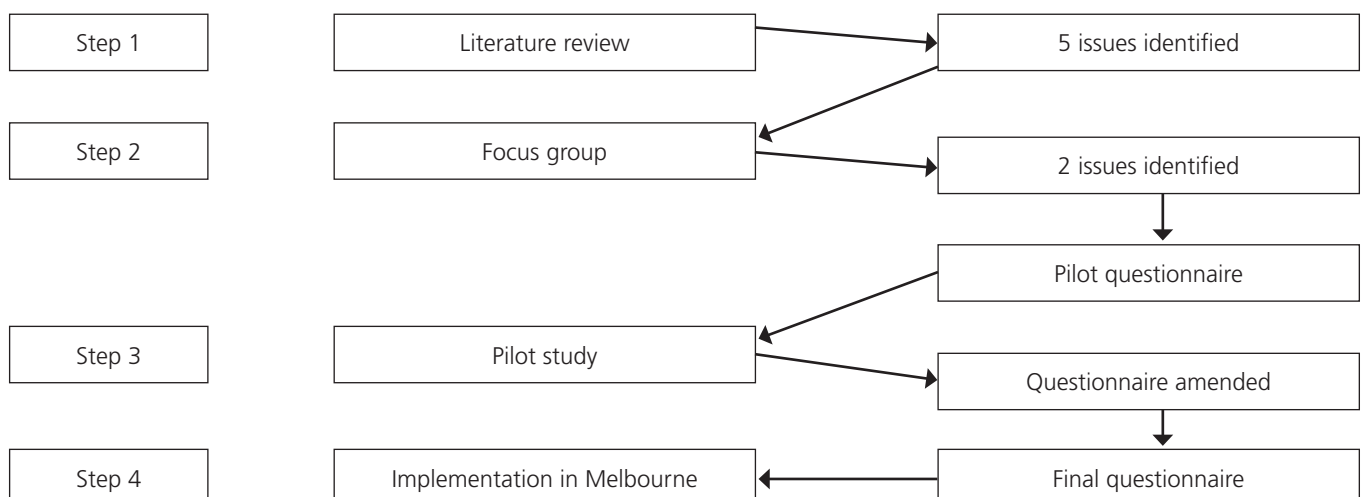
In 2013, the collective membership of HTNZ and AHTA therapists was estimated to be 450. Recruitment of conference attendees ($n = 250$) was via a poster in the registration area and announcements made at the conference. Respondents who completed hard copies of the participant information sheet, consent form, and SiOQ went into a draw to win an iPad mini.

Data analysis

Data were entered into Microsoft Excel for analysis. Respondent demographics and Likert scale responses were analysed using frequency counts. Likert response categories were ranked numerically and then multiplied by the frequencies. This weighted analysis (Norman, 2010) gave an overall combined score out of 5 points. This score, termed "level of agreement", reflected the respondent's viewpoint of each statement on the

Figure 1

Overview of Study Design



Likert scale. Zero agreement is reflected by a 0 score, whereas strong agreement has 5 points. Written responses to open-ended questions were grouped according to thematic content by GD, with frequency counts performed for reporting purposes.

RESULTS

Demographics

The response rate from the hand therapists attending the combined conference was 50.4% ($n = 126$). All respondents were qualified therapists, who had either completed occupational therapy ($n = 72$) or physiotherapy ($n = 51$) training. All but three respondents provided hand therapy professional membership status and country of registration. The respondents reported a wide range of hand therapy experience (1-40 years), with a mean of 12 years ($SD = 9$). Of the respondents, 22 held postgraduate qualifications of either a master's degree or above, with three holding doctorates.

SiO usage

In regard to SiO usage, 43% ($n = 54/126$) of respondents reported using SiO in their clinical practice. However, only 24% ($n = 30/126$) currently used SiO. A third of respondents ($n = 42/126$) were unaware of the existence of SiO as a therapeutic adjunct for hand therapy (Figure 2). The demographics of the SiO users ($n = 54$) compared to those who had never used SiO ($n = 72$) were similar (Table 1). A greater number of hand therapists with physiotherapy training (62%, $n = 34/54$) reported use of SiO in their clinical practice compared to those with an occupational therapy background (37%, $n = 20/54$).

Agreement on clinical attributes of SiO

The highest overall level of agreement for all respondents ($n = 54$) that had used SiO was that immersion was an acceptable and appropriate therapeutic adjunct for the management of open hand wounds (level of agreement score, 4.1/5). The second area of strong respondent agreement concerned the

Figure 2

Summary of Respondent Awareness and Usage of Silicone Oil

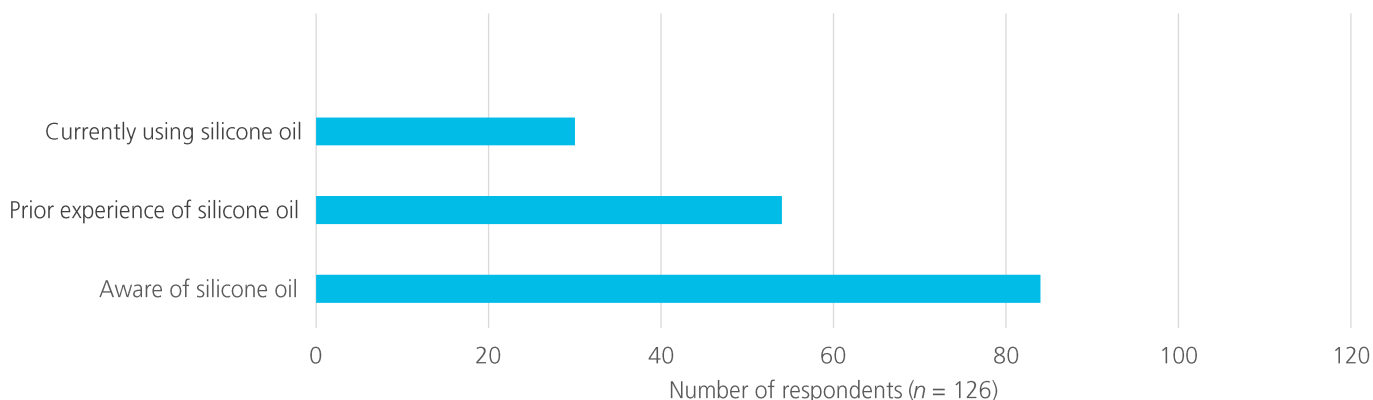


Table 1

Demographics of Respondents Separated by Silicone Oil Use

| Total respondents in survey ($n = 126$) | Silicone oil users ($n = 54$) | Never used silicone oil ($n = 72$) |
|--|------------------------------------|---|
| Response rate (total 50.4%) | 43% | 57% |
| Physiotherapist | 34 | 17 |
| Occupational therapist | 20 | 55 |
| Average years worked | 14 | 11 |
| Range of years worked | 1–40 | 0–32 |
| Private practice | 41 | 48 |
| Public practice | 13 | 24 |
| Master's degree or doctorate | 11 | 11 |
| New Zealand registered | 30 | 4 |
| Australian registered | 10 | 32 |
| Registration not stated | 14 | 36 |

positive impact of SiO on wound dressing changes, with the perception that dressing changes were atraumatic after SiO use (level of agreement score, 4.6/5). Respondents agreed that SiO allowed hand movement with less pain (level of agreement score, 3.8/5). The lowest level of agreement between SiO users (level of agreement score, 3.6/5) related to the risk of infection associated with SiO use (Table 2).

Reasons for non-usage of SiO

The most frequent reason for non-usage of SiO was its nonavailability in the clinic ($n = 13$) (Figure 3). Additional reasons included a lack of product knowledge combined with perceived limited clinical evidence for SiO use, and concerns over cleanliness and hygiene. Cost and the requirement for a doctor's referral were also reasons for nonuse. The free text responses regarding SiO disadvantages included responses about the "complex" and "messy" nature of the intervention, which has a "risk of spillage" (Appendix A, question 18). In addition, SiO was reported as "requiring a high level of cooperation and commitment from patients when used at home".

Reasons for use of SiO

Therapists reported SiO for specific use in the post-surgical management of Dupuytren's contracture release (26%, $n = 14$) (Figure 4). Reasons for clinical use included "wound care" and "improved wound healing time", which together equalled 35% ($n = 19$); gaining range of movement (11%, $n = 6$); at the surgeon's request (9%, $n = 5$); and for scar management (9%, $n = 5$). Respondents comments about perceived benefits included terms such as "soothing", "pain-free effect", and "less tightness when moving". The most cited observations related to the enhancement of wound healing: "faster wound healing" and "softer dead skin allowing for simpler debridement" (Appendix A, question 17).

DISCUSSION

A quarter of the therapists surveyed used SiO, and strongly agreed that SiO was effective for open wound hand rehabilitation as it made movement less painful. Therapists stated that SiO was used specifically for post-surgical

Table 2

Level of Agreement Scores for Therapeutic Implications of Silicone Oil

| Therapeutic implications | Level of agreement ^a | |
|--|---------------------------------|-------------------------------------|
| | Have used SiO ($n = 54$) | Current user of SiO ($n = 30$) |
| Can be used for open wounds | 4.1 | 4.2 |
| Assists with atraumatic dressing changes | 4.0 | 4.1 |
| Less pain with motion | 3.8 | 4.0 |
| No adverse effects | 3.8 | 4.1 |
| Assists with gaining motion | 3.7 | 3.4 |
| Additional cost | 3.7 | 3.7 |
| Decreased risk of infection | 3.6 | 4.4 |

Note. SiO = silicone oil.

^a Answers scored on a 5-point Likert scale; an overall "level of agreement" score of 0 indicates no agreement, with 5 indicating total agreement.

Figure 3

Reasons for No Longer Using Silicone Oil

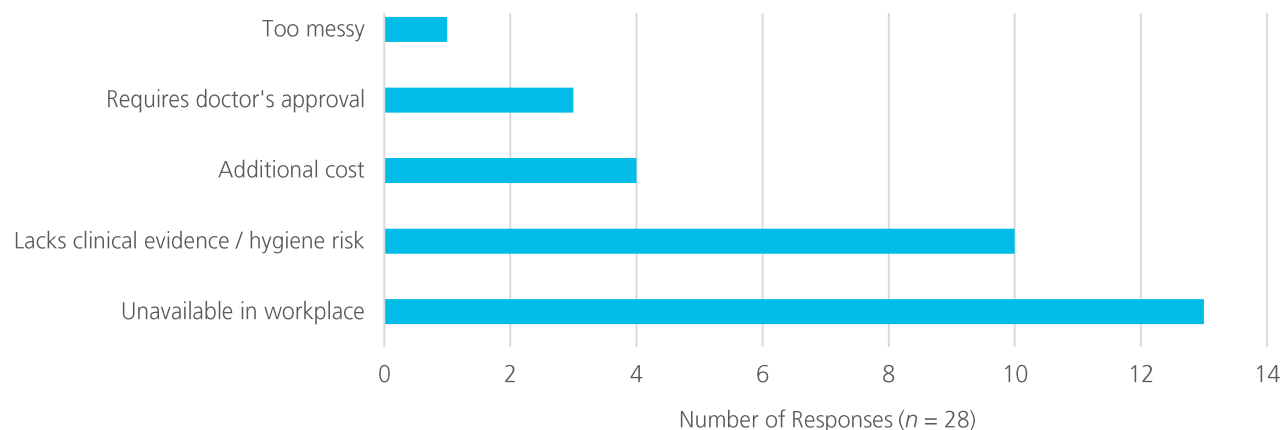
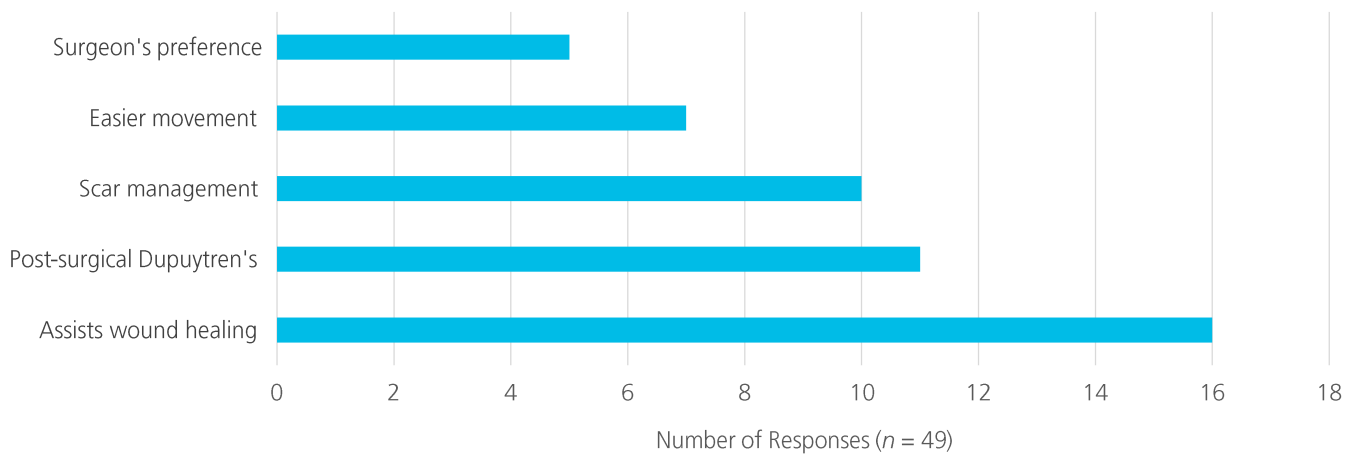


Figure 4

Reasons for Current Use of Silicone Oil



Dupuytren's rehabilitation. However, a third of therapists surveyed were unaware of SiO usage as an adjunct in hand rehabilitation.

The survey identified a range of clinical issues. Nonavailability of SiO at hospitals and clinics was one reason preventing therapists from incorporating SiO into rehabilitation programmes. Another factor impacting therapists' usage was that, at the time of administration of this questionnaire, SiO required a doctor's prescription. However, the New Zealand Government changed the medical classification of SiO to a medical device in 2014 (New Zealand Government, 2013), which means it can now be incorporated into a care plan by a therapist based upon clinical reasoning.

From the results of this study, we can hypothesise that therapists with limited product knowledge are less likely to use SiO. However, this was not tested using statistical methods. Some respondents expressed concern regarding the risks of infection, cleanliness, and a lack of clinical evidence for SiO use. These concerns are valid as there is a paucity of literature in this area of hand therapy. Nevertheless, literature that does exist suggests that infection is not a concern. For example, the study of Thurston and McChesney (2002) examined SiO use for hand-wound rehabilitation and found that SiO did not support the growth of bacteria, despite the wound testing positive for bacterial growth.

Furthermore, while not in the field of hand research, there has been extensive investigation of SiO and infection in ophthalmic laboratory research. This body of work has identified strong antimicrobial properties associated with SiO, particularly against staphylococcal pathogens (Arici et al., 2016; Chrapek et al., 2012; Ozdamar et al., 1999). Intraocular injections of antibiotics with and without SiO found treatment with SiO rapidly controlled infection and achieved better visual acuity when compared to intraocular injection of antibiotics alone (Bali et al., 2003). The research documenting antimicrobial and anti-inflammatory properties of SiO is limited to ophthalmic research (Aras et al., 2001; Bali et al., 2003; Chrapek et al., 2012).

Conversely, therapists may be cognisant of literature detailing Swanson's silicone arthroplasty implants, used for finger joint replacements in arthritis (Bales et al., 2014; Swanson, 1972). Early publications reported complications with implanted silicone joint replacements, such as particulate synovitis, lymphadenopathy, and the formation of granuloma tissue (Christie et al., 1977; DeHeer et al., 1995; Kircher, 1980). However, Thurston (1997) reviewed 116 hand wounds mobilised in SiO over a 12-year period and did not find any of the adverse effects associated with implanted silicone such as granuloma, areas of inflammation or abnormal scar formation.

In contrast to the wide range of traumatic injuries and diagnoses associated with SiO usage in the earlier literature, the current study found post-surgical Dupuytren's commonly cited as the reason for SiO use. Hand therapists frequently see traumatic injuries, such as burns, de-gloving injuries, and tendon lacerations, and these share similar therapeutic goals to post-surgical Dupuytren's (Warwick, 2015), such as restoring motion with the least pain possible during wound healing. In the current study, therapists' perceptions regarding less pain with motion are consistent with previous authors who state, "The hand can be exercised with less pain than otherwise would occur" (Helal et al., 1982). Given this consistency, the rare citing of traumatic injuries as the reason for SiO use is surprising. The absence of published protocols that recommend SiO use for traumatic injuries may be a factor. Tendon repair rehabilitation, for example, is guided by very prescribed criteria, such as Kleinart (Hundozi et al 2013), Washington (Dovelle & Heeter, 1989) and Saint John (Higgins & Lalonde, 2016), but none suggest SiO use. In the absence of published protocols that specify SiO use, therapists may be reluctant to modify their current practice. Thurston (1997) details SiO use in post-surgical Dupuytren's, which may explain the use of SiO for this specific pathology.

Therapists in this study strongly agreed (4/5) on the utility of SiO in the daily replacement of wound dressings, where patients report less pain during dressing changes after SiO use. Spira and colleagues (1967) pioneered the use of SiO in plastic bags

for the treatment of burned hands. The bag containing SiO acts as a form of dressing, while the sealed space within the bag allows unrestricted finger motion, which is advantageous during rehabilitation. Subsequently, silicone impregnated dressings were developed (Cutting et al., 2009; Platt et al., 1996). Silicone dressings adhere readily to intact skin, but do not stick to the moist wound surface. Subsequently, a lesser nociceptive stimulus occurs when the dressings are removed (White, 2005). Less pain and stress improve the speed of wound healing (Broadbent et al., 2003; Matsuzaki & Upton, 2013; McGuire et al., 2006; Upton & Solowiej, 2010), and these findings are consistent with therapists' perceptions that SiO usage heals hand wounds faster, with less pain experienced during range of motion exercises and atraumatic wound dressing changes.

The literature lacks studies on patient perceptions of SiO. Therefore, future studies should evaluate both the efficacy of SiO and qualitative investigation with the use of patient-rated outcome measures.

The strengths of this study include careful development of the questionnaire using Likert scales to ascertain therapists' opinions on SiO, and the trial and refinement of the questionnaire before it was administered. The response rate achieved was acceptable (Richardson, 2005), although 60% would have been desirable to reduce sample error and bias.

Study limitations include the use of a local regional sample for pilot testing and the absence of a working definition of SiO on the questionnaire. A clear definition of SiO may have eliminated possible respondent confusion. Seven respondents alluded to the point that SiO was helpful for scar management although it is silicone gel sheets that are explicitly designed and routinely used by therapists for scar care (Sawada & Sone, 1990). Furthermore, the results of the study cannot be generalised beyond the conference attendees, and data collection was undertaken over seven years ago. Therefore, the views expressed are not representative of hand therapists worldwide.

CONCLUSION

This study found that 43% of therapists surveyed had used SiO as an adjunct in hand rehabilitation for the management of open hand wounds within New Zealand and Australia. Therapists surveyed agreed that SiO use permitted movement with less pain. Furthermore, therapists perceived that SiO use contributed to faster healing and atraumatic wound dressing changes.

The practical implications of this study include recognition of the low level of therapists' product knowledge and research relating to SiO. Therapists need easy access to recent evidence to support their clinical use of this adjunct. Surgical release of Dupuytren's hand joint contracture is a common surgery in New Zealand and a specific reason for clinical use of SiO. Addressing the nonavailability of SiO in the clinic could make this simple adjunct to hand rehabilitation more common in clinical practice where indicated.

This research highlights beliefs commonly held by New Zealand and Australian therapists regarding SiO, and raises the profile of SiO as an adjunct therapy for hand wounds. Investigation of the effectiveness of SiO to improve wound healing, for example, in post-operative Dupuytren's contracture release wounds, is needed to improve clinical practice. Future research should first evaluate the feasibility and acceptability of treatment regimens, for example, using SiO in a home-based exercise programme, taking into account both clinicians' and patients' perspectives.

KEY POINTS

1. A quarter of hand therapists surveyed reported SiO use.
2. Therapists strongly agreed that SiO used in wound care permits movement with less pain.
3. Therapists agreed that SiO use impacted positively on wound dressing changes.
4. SiO is used specifically for post-surgical Dupuytren's rehabilitation.

DISCLOSURES

No funding was obtained for this study. There are no conflicts of interest which may be perceived to interfere with or bias this study.

PERMISSIONS

Ethical approval was obtained from the University of Otago Human Ethics Committee (reference number D13/346).

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ADDRESS FOR CORRESPONDENCE

Gail Donaldson, Centre for Health, Activity and Rehabilitation Research, (CHARR), School of Physiotherapy, University of Otago, PO Box 56, Dunedin, New Zealand.

Email: donga671@student.otago.ac.nz

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Appendix A

THE SILICONE OIL IN HAND REHABILITATION QUESTIONNAIRE

This survey is being conducted by Gail Donaldson as part of her doctoral study being conducted at the University of Otago. This is a confidential survey which is being conducted to ascertain the level of usage and professional opinion of silicone oil held by New Zealand and Australian hand therapists.

**Instructions: Please mark each question with a tick.
Provide answers when prompted and grade your responses as applicable.**

- 1. Your professional registration status is:
 Physiotherapist Occupational therapist
 New Zealand registered Australian registered

- 2. Your highest academic degree is:
 Registered/certified hand therapist
 Master's degree
 PhD

- 3. How many years of hand therapy experience do you have?
_____ years

- 4. The predominant area of your professional hand therapy practice is:
 Private practice Public sector

- 5. Are you aware of the use of silicone oil in relation to hand therapy rehabilitation?
 Yes No

- 6. Have you ever used silicone oil for your patients in hand rehabilitation?
 Yes No

- 7. Do you currently use silicone oil for your patients in hand rehabilitation?
 Yes No

- 8. If you currently use silicone oil, please state your reason for doing so.

- 9. If you do not currently use silicone oil or have done so in the past, please state your reason for not doing so now.

Please mark on the line the point that best describes your opinion regarding the therapeutic implications of silicone oil in the following statements.

- 10. Silicone oil immersion can be used in the presence of open wounds
|-----|-----|-----|-----|-----|
Disagree Not sure Agree

- 11. Silicone oil immersion helps improve range of motion of the hand
|-----|-----|-----|-----|-----|
Disagree Not sure Agree

- 12. Silicone oil immersion allows movement with less pain
|-----|-----|-----|-----|-----|
Disagree Not sure Agree

- 13. Silicone oil immersion assists with atraumatic dressing changes
|-----|-----|-----|-----|-----|
Disagree Not sure Agree

- 14. Silicone oil has adverse effects
|-----|-----|-----|-----|-----|
Disagree Not sure Agree

- 15. Silicone oil is costly
|-----|-----|-----|-----|-----|
Disagree Not sure Agree

- 16. There is increased risk of infection with use of silicone oil
|-----|-----|-----|-----|-----|
Disagree Not sure Agree

- 17. Do you want to add any additional comments about the perceived benefits of silicone oil in regard to hand rehabilitation?

- 18. Do you want to add any additional comments about the disadvantages of silicone oil?

