

Skin Health Study in Waterproof Casts

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ABSTRACT: This study evaluated patient satisfaction and skin integrity after immobilization with AquaCast® waterproof liner. Waterproof liner, an emerging technology, is designed to allow proper fracture immobilization, participation in water activities and improved hygiene. Only short arm, long arm, or short leg casts were included. This study was a retrospective non-randomized survey with de-identified patient information. The study included seventy-two patients, aged 24 months to 64 years (mean 11.7 years). Reduced fractures were excluded. AquaCast Liner was provided free for participation. Seventy-one out of seventy-two patients (98.6%) wearing AquaCast Liner had average or better skin quality. Seventy-one out of seventy-two patients would recommend AquaCast Liner to others. All fractures healed without complication.

INTRODUCTION: Acute fractures are a common reason for orthopedic consultation. In the preceding 12 months, a total of 679 short arm, long arm, and short leg casts were applied at Towson Orthopedics Associates, including both surgical and non-surgical patients. The gold standard non-waterproof cast immobilization for non-displaced fractures limits swimming and prevents good hygiene particularly in pediatric and adolescent patients. Casting techniques have advanced from plaster casts (inexpensive, non-waterproof and heavy), to fiberglass, (lighter and waterproof). Fiberglass, while a large improvement over plaster, still required restriction of water activities and made proper hygiene challenging due to the underlying cotton layer required to protect the skin. Patients with standard cast material often report problems with itching and foul odors¹. The retention of moisture in the cotton layers have resulted in cutaneous complications including bacterial infections, maceration, ulceration, rashes, and contact dermatitis².

As society demands more convenient and waterproof options for immobilization after fracture, more studies need to be completed to determine their efficacy and safety. There have been a number of different brands on the market including Gore Procel®, Delta Dry®, and AquaCast Liner. The Procel product is no longer available on the market. AquaCast Liner was introduced in 2012 as an improved version and alternative to the Procel liner.

In the late 1960s a material called ePTFE or Expanded Polytetrafluoroethylene was brought to the market³. It is a non-absorbent (waterproof), highly breathable membrane. AquaCast Liner is comprised of this material. The liner contains billions of tiny pores. These pores are much larger than vapor molecules but smaller than liquid water droplets. This technology allows the AquaCast waterproof liner to remain dry while the skin gets wet. Water drains quickly out of the ends of the cast. The patient's body temperature heats up the remaining water causing it to vaporize and pass through the liner and the fiberglass cast tape.

Likewise, when a person perspires, the liquid is not absorbed by the cast liner. It vaporizes and passes through the liner and fiberglass. This is in contrast to casts with cotton lining where the cotton absorbs and holds the moisture next to the skin for extended periods of time.

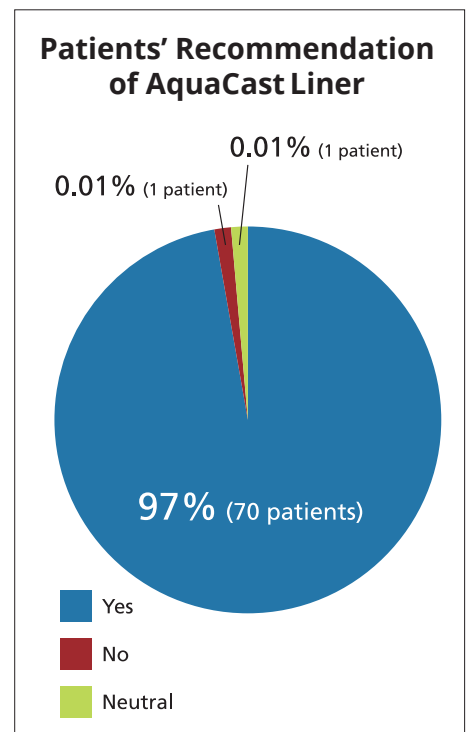


TABLE A: Patients who would recommend AquaCast Liner.



FIGURE 1: Application by orthopaedic technologist of AquaCast® Liner on patient requiring short arm immobilization.



FIGURE 2: Application of Saw Stop® cast removal aid strips.



FIGURE 3: Finished application of waterproof padding awaiting application of fiberglass casting tape.

MATERIALS AND METHODS

The study sample was a non-randomized group of children and adults treated May 2013 to May 2014. Inclusion criteria were patients with stable fractures requiring short arm, long arm or short leg cast application. Exclusion criteria included fractures that required open or closed reduction or pre-existing skin abrasions or wounds. Eligible patients were given the option of standard stockinet and cotton cast

padding or AquaCast waterproof liner. Routine fiberglass casting tape was used for the top layer on all casts. The waterproof liner was donated for the study by AquaCast Liner.

The application of AquaCast Liner is very similar to traditional cotton padding. It requires 2-3 layers of liner and extra padding over all bony prominences. A blue or white safety strip is applied on the top of the liner (but under the fiberglass) as a protective layer

for cast removal. Patients and parents were given oral and written instructions by an orthopedic technologist for maintenance and care of the waterproof cast. Patients were cautioned to dry the cast thoroughly prior to bed. They were instructed to rinse the cast with clean water after sports practice or swimming. After rinsing cast, a towel is wrapped around the cast for 5-10 minutes to remove excess water. Patients were counseled to avoid the ocean and sand. Complete drying generally takes less than 60-90 minutes in the summer. Using a hair dryer on cool may expedite the drying of the cast.

At time of cast removal, a survey was completed by the patient or parent. The survey included type of cast, length of immobilization (weeks), patient age, frequency of swimming, bathing, or sporting activity, average amount of time required for cast to dry completely, and overall cast satisfaction. Patients could comment about ways to improve their experience and whether they would recommend this cast liner to others. Skin integrity was evaluated by an orthopedic technologist or physician at the time of cast removal and rated as excellent, good, average, or poor.

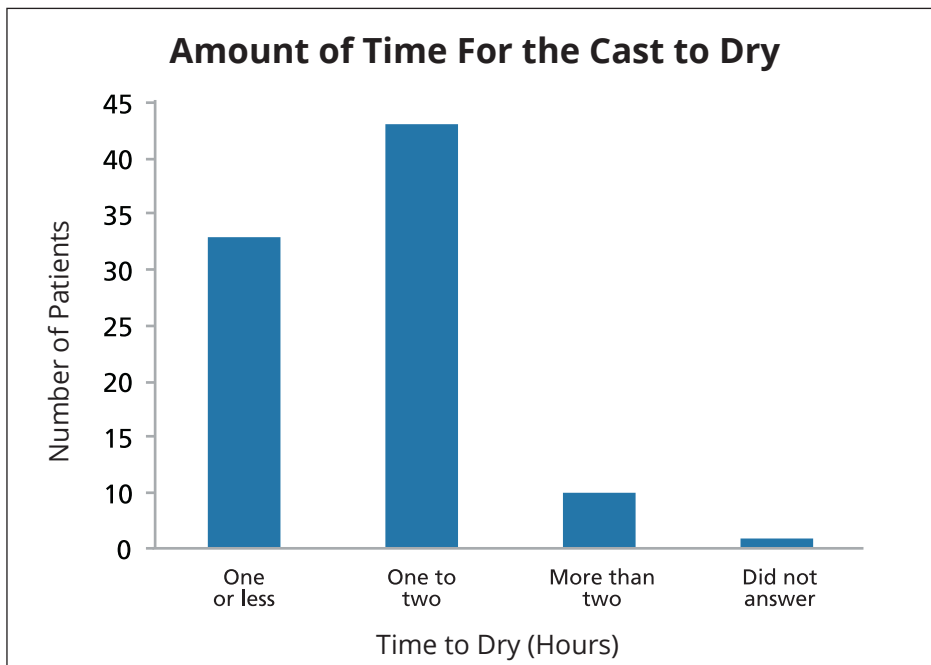


TABLE B: Patient reported time for the cast to dry after immersion in water.

RESULTS

During the one year study period 72 patients from 2 different physicians met inclusion criteria, had an AquaCast® waterproof casting liner applied, and completed the survey. Some surveys, included in the data, did not include any comments and were limited in their completeness in duration of physical activity.

While the application of the waterproof casting liner was available for all ages, the mean age of patients in the study was 11.7 years and median age was 11 years old. The average time of 3.4 weeks.

None of the 72 patients had loss of fracture alignment or modification of treatment plan. One patient had poor skin quality noted at the completion of the casting period, but note was made in the survey by orthopedic technologist that the cast had not been properly rinsed during immobilization period. One patient developed a pruritic rash after approximately 2 weeks of immobilization. She had her cast removed at that time. Continued immobilization was not required. The patient's skin quality was rated average. The rash resolved shortly after cast removal. No further follow up or dermatology consultations were required.

Seventy-one out of 72 patients (98.6%) wearing AquaCast waterproof liner were noted by an orthopedic technologist to have average or better skin quality (Average, Good or Excellent). Only 1 patient was noted to have poor skin quality (1.4%). Interestingly, both short arm and short leg casting had evaluations of excellent skin quality >50% (55.4% and 71.4% respectively) however, long arm cast had only 33.3% excellent skin quality.

While the cast instructions suggest it will take AquaCast Liner 3-4 hours to dry, the majority of patients (52.8%)

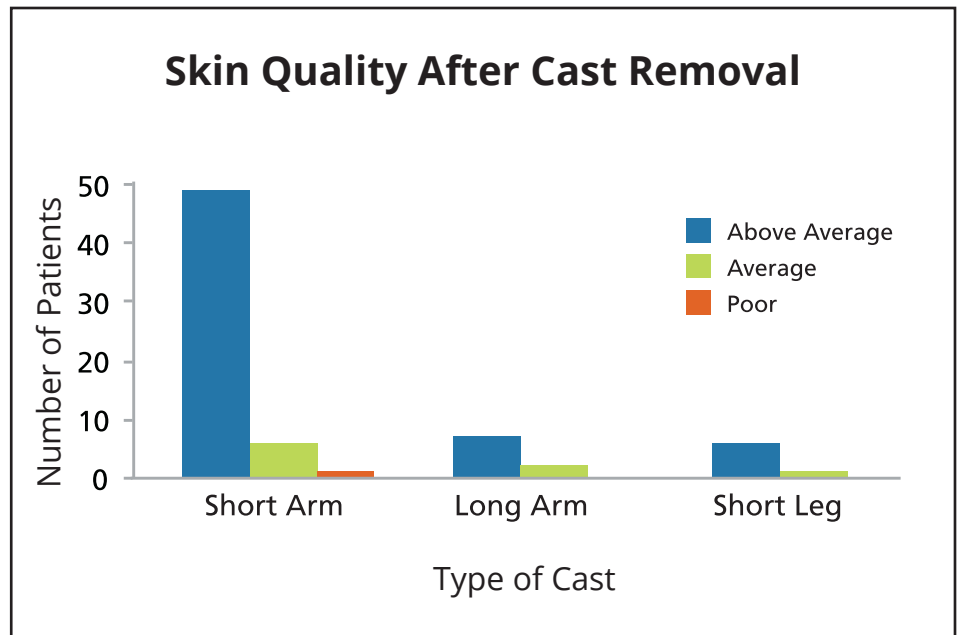


TABLE C: Clinician's evaluation of skin quality after removal of a cast containing AquaCast Liner.



FIGURE 4: Orthopaedic technologist applying and molding fiberglass casting tape over waterproof cast padding.

reported only 1-2 hours to dry. 38.9% reported it took one hour or less to dry. Only 6.9% of patients reported it taking more than 2 hours to dry. One patient did not complete the question.

Overall 71 out of 72 patients would recommend AquaCast® Liner to others. Patients liked that AquaCast Liner allowed them to continue their daily activities without inconvenience. For example, one mother responded “Easy to shower and swim.” Many patients and parents familiar with prior casting experience also commented on less odor. “Showering helped with the smell” while another commented that the cast “was not itchy”. A few negative comments typically included complaints of a sticky feeling, “Felt sticky unless washed frequently”. Other patients commented on needing “more padding around thumb”.

DISCUSSION

While there are many offices not using waterproof casting liners, AquaCast Liner and other waterproof casting liners are proving to have great patient satisfaction. A previous study by Dr. Harlan Selesnick, reported 342 out of 344 patients who received a waterproof cast liner would recommend the waterproof liner to others with similar injuries¹.

In a similar study performed by Shannon et al at Children’s Hospital Boston, the Gore Procel® liner obtained a similar satisfaction rating with 79% of patients and parents who were very satisfied. In that study there were a few minor skin complications that resolved within 2 days².

A prospective study, by Robert et al. demonstrated no difference between cotton or waterproof Gore cast liner in the radiographic outcome of displaced distal third radius and ulna

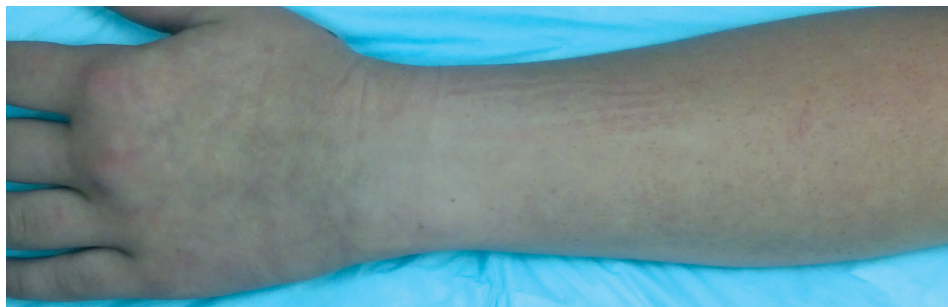


FIGURE 5: Patient's arm prior to waterproof cast padding and cast being applied.

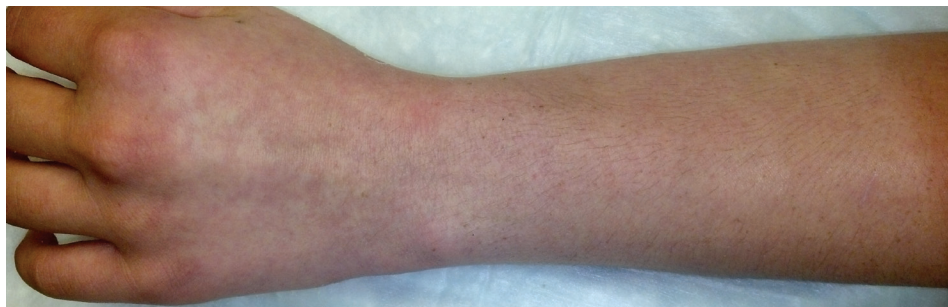


FIGURE 6: Patient's arm after removal of waterproof padded cast showing skin health.



FIGURE 7: Patient's arm after removal of waterproof padded cast showing skin health.

fractures even after closed reduction⁴.

Our study limitations include the retrospective design and lack of control group. The predominance of short arm cast application may limit the applicability of our study to all casting types-cylinder, long leg, etc. It was difficult to control for cast care at home. Additionally, our patient population was predominately pediatric patients with stable fractures, so further studies evaluating the efficacy of the AquaCast Liner should be completed in an adult population.

Finally, the heavy bias towards the pediatric population shortened the average time of immobilization. The average period of immobiliza-

tions was average of 3.4 weeks, many fractures require upwards of 6-8 weeks of immobilization. Duration of immobilization could potentially affect the frequency of skin issues. Quality of survey completion was also a limitation. Many surveys did not answer questions regarding frequency of showering and athletics, so this data was not reported in the study results.

In conclusion, the field of orthopedics and sports medicine continues to advance to meet the demands of patients and their active lifestyles. AquaCast waterproof cast liner provides an opportunity for proper immobilization without inhibiting patients' lifestyles dramatically.

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