

Decreasing adhesions and avoiding further surgery in a pediatric patient involved in a severe pedestrian *versus* motor vehicle accident

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Abstract

In this case study, we report the use of manual physical therapy in a pediatric patient experiencing complications from a life-threatening motor vehicle accident that necessitated 19 surgeries over the course of 12 months. Post-surgical adhesions decreased the patient's quality of life. He developed multiple medical conditions including recurrent partial bowel obstructions and an ascending testicle. In an effort to avoid further surgery for bowel obstruction and the ascending testicle, the patient was effectively treated with a manual physical therapy regimen focused on decreasing adhesions. The therapy allowed return to an improved quality of life, significant decrease in subjective reports of pain and dysfunction, and apparent decreases in adhesive processes without further surgery, which are important goals for all patients, but especially for pediatric patients.

Introduction

In 2010, motor vehicle accidents (MVA) accounted for 3421 injuries and 1428 fatalities of children under the age of 15. Pedestrian involved MVAs for children under the age of 15 have a high fatality rate (85%), with only 52 of 345 children surviving the accidents. Of the 52 children that survived, 33 (63%) were severely injured.¹ Thus, 326 of 345 (94%) died, or were severely injured. Those children that survive severe injuries often undergo weeks of hospitalization followed by lengthy recovery and rehabilitation periods after the initial MVA. After recovery from the initial trauma, patients with extensive surgical and/or trauma histories are at high risk for further complications and hospitalizations due to the formation of adhesions.²

Adhesions are fibrous bands of connective tissue that bind the skin and/or internal structures (organs, muscles, bones, connective tissues) into abnormal formations that frequently

impact their normal function. The formation of adhesions is not an aberrant occurrence, but can be considered an overzealous healing process of the body in which a structural matrix is created in an anatomically incorrect location. With each successive surgery, there is an increased risk of developing adhesions with the potential for developing life threatening conditions such as bowel obstructions, reduction in respiratory capacity,^{3,4} and cardiac function,⁵ as well as causing pain. Physical trauma also has the ability to generate adhesions, particularly in instances of life threatening trauma.⁶ Adhesions have been identified as contributing to a wide variety of conditions including pain, infertility, bowel obstruction and decreased range of motion, thereby significantly impacting the patients' quality of life.⁷⁻⁹

Adhesion formation is of particular concern in pediatric patients because of its ability to negatively impact children's quality of life. These internal scars can impact the child's diet, ability to participate in sports, or normal play. Abdomino-pelvic adhesions may contribute to the requirement for daily medication for pain or bowel maintenance for the remainder of the patient's life in order to function at a level close to that of non-traumatized children.¹⁰ There is also a strong potential for pain and additional medical complications as the pediatric patient enters periods of rapid growth. Here we present a case involving the use of a site-specific manual physical therapy to treat a young child that was involved in a MVA as a pedestrian, sustained severe injuries, and developed severe scarring and adhesion formation that affected his quality of life significantly because of healing from those injuries.

Case Report

The patient was an 11 year old boy who had been involved in a MVA *versus* pedestrian accident in which a large vehicle rolled over his pelvis, resulting in an open book pelvic fracture, splitting the osseous structure of his pelvis. He sustained life-threatening injuries for which he underwent 19 surgeries over the course of one year in order to repair damage that resulted from the accident (Table 1). Because of healing from both the number of surgeries and trauma from the accident, the patient developed extensive scarring and abdominal adhesions as well as post traumatic stress disorder (PTSD). He had traditional physical therapy for three months to facilitate his ability to walk and perform daily functions. However, the patient experienced recurrent partial small bowel obstructions (SBO) that were treated non-surgically, and he required a laxative, polyethylene glycol (PEG) 3350 – oral, for maintenance of bowel function. The use of

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Key words: physical therapy techniques, tissue adhesions, pediatrics, musculoskeletal manipulations.

Contributions: the authors contributed equally.

Conflict of interests: BFW and LJW are the sole shareholders of Clear Passage Therapies, Inc. Wurn Technique is a Therapeutic Method for Treating Infertility in Humans and Animals, patent pending with the United States Patent and Trademark Office, Application No. 09/887,884 filed June 22, 2001, by Lawrence J. Wurn and Belinda F. Wurn. Clear Passage ApproachTM is registered to Lawrence and Belinda Wurn. All other authors declare no conflicts of interest.

Funding: none.

Received for publication: 14 October 2013.
Accepted for publication: 16 January 2014.

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Licensee PAGEPress, Italy
Pediatric Reports 2014; 6:5126
doi:10.4081/pr.2014.5126

laxatives caused the patient distress and reportedly impacted his life significantly, causing rectal fecal leakage and thus furthered emotional distress in a pediatric patient medicated for PTSD.

Upon initial physical therapy evaluation at a specialized manual therapy clinic, 19 months following the accident, the patient reported frequent constipation, pain of up to 7/10 during bowel movements, weakness and tingling in his left lower extremity and general pain that increased throughout the day. He expressed numerous goals, including the ability to participate in more athletic activities, to run a marathon, and to eliminate the requirement for pharmaceutical maintenance of bowel function. Findings from the initial evaluation, which included visual, palpatory, postural and movement exams were correlated with patient medical history, previous surgical reports, and physician diagnosis to determine adhered and dysfunctional areas requiring treatment. Restrictions, scars or adhesions were palpated by the therapists, major organs were identified, and decreased mobility of specific organs was determined. The patient was ambulatory, but exhibited a shuffling gait and a wide base of support with both hips held in external rotation.

He presented with decreased range of motion in several areas that impacted his activities of daily living (Table 2), decreased strength, postural deviations, and biomechanical dysfunction, as well as myofascial, visceral and osseous restrictions due to scarring and adhesion formation after the original trauma, and from the 19 required surgical interventions. The extensive adhesions in his pelvis had also caused his left testicle to ascend into the inguinal canal where it was unable to be palpated, but was visible by diagnostic ultrasound.

The patient was treated with an intensive site-specific manual physical therapy called the Clear Passage Approach (CPA) or Wurn

Technique for 4 hours a day for 5 consecutive days (a total of 20 hours). In accordance with the American Physical Therapy Association guidelines, detailed clinical treatment records were maintained on the patient throughout the course of therapy. These included symptomatic complaints, areas treated, duration and techniques performed. Unlike traditional physical therapy that often consists of exercise and modalities, the CPA utilizes a variety of techniques focused on creating microfailures of the adhesions by a variety of site-specific sustained pressures across restricted fascial bands of adhered tissues and organs.¹¹ The amount and time of force that was applied to

cause these microfailures was often significant, but varied with the tolerance of the patient and according to the location and delicacy of the tissues that were being treated. In previously published clinical trials and studies, these techniques increased range of motion, reversed infertility, prevented SBO and decreased pain in patients with histories indicating significant adhesion formation.¹²⁻¹⁵

Therapy focused on decreasing adhesions in order to decrease pain, and to increase function and range of motion. The patient's response to treatment was significant and readily apparent to him, the therapists and his physicians. Following the initial 20 hours of

Table 1. Medical treatment timeline beginning at the initial trauma caused by the collision of a motor vehicle with the patient as a pedestrian.

D	Event	D	Event
0	Open laceration to the L inguinal crease through L hemiscrotum to perineal body ending anterior andoderm with a depth to the femoral artery; L extremity no pulse, cool and endematous, multiple bone fracture fragments in pelvis and leg	1	Loop colostomy (right upper transverse); central line placement; left femoral artery angioplasty with bovine pericardium; left lower extremity fasciotomy of leg and foot; external fixation of open book left and right pelvic fracture (AO external pelvic fixator); exposure of entire left leg external iliac artery, left common femoral artery, superficial femoral and profundus femoral artery (balloon thrombectomy iliac arteries, patch of left external iliac artery, patch of common femoral artery, ligation of disrupted external iliac vein*
2	Partial closure of pelvic wound; small amount of necrotic scrotal tissue removed; 1600 cm ² VAC dressing change to pelvis and lower left extremity fasciotomies*	3	Washout of fasciotomies and pelvic wound; change of central line; placement of 1400 cm ² VAC dressing*
4	Irrigation and debridement of open pelvic wound with 218 cm ² VAC dressing applied*	5	Irrigation and debridement of open pelvic wound with 200 cm ² VAC dressing applied*
6	Pelvic wound washout; closure of pelvic wound; VAC dressing change to L lower extremity AO external pelvic fixator removed; placement of bilateral 7.3 mm cannulated screws and washers in SI joints; non-weight bearing status continued*	9	Closure of lower L fasciotomies (2 leg, 2 foot); VAC dressing change to medial fasciotomy on L foot
12	Closure of L foot fasciotomy; wound washout of pelvis, placement of mepilex silver dressing and Tegaderm*	21	Removal of left thigh drains; removal of sutures; closure of 12 cm perineum and left groin wound
26	Discharged from hospital	37	On Percocet prn; Neurontin 300 mg Q8 for neuropathic left leg pain; suspect PTSD diagnosis
75	Extensive scar over L scrotum; L testis ascending	77	5 cm perineum wound closure; 2 ml granulated tissue removed; wound 1.5 cm deep*
106	3 cm perineum wound suture removal from previous surgery; repeat wound closure	133	2.5 cm perineal wound debridement and closure; scar tissue and granulation tissue removed*
161	1.5 cm area skin dehiscence and underlying granulation tissue with visible sutures; re-closure*	176	1.5 cm lesion in perineum; ordered 3 sitz baths/day
204	8 mm perineum wound still flat, granulated tissue; ordered 3 sitz baths/day	226	Removal of bilateral SI screws*
252	L testis ascended due to extensive scarring close to scrotal region	267	5 mm ulcer anterior to anal verge; ordered 3 sitz baths/day
336	Colostomy reversal*	353	Large bowel obstruction with transverse colon anastomotic edema*
359	Fascial dehiscence at colostomy reversal site with significant wound infection; drain placed during surgery*	365	Drain removed
366-590	Multiple episodes of SBO symptoms treated non-surgically	590	20 hours manual physical therapy
642	Scrotal scar improved after manual physical therapy; urologist recommended additional therapy at CPT prior to any surgical intervention for ascending L testis	793	20 hours manual physical therapy

D, day post trauma; L, left. *Surgical interventions.

treatment, the patient demonstrated an apparent decrease of adhesions evidenced by increased range of motion (Table 2) of by at least 5 degrees for abnormal tests, and by improved myofascial, visceral and ligamentous mobility accessed via palpation. He reported decreased abdominal pain, increased frequency of normal bowel movements, and decreased use of laxatives by 50%.

Upon urologic re-evaluation, his physician reported that the scar adhesions in his scrotum had decreased significantly. The urologist was optimistic that additional treatment would continue to decrease the scarring in his left inguinal region in order to aid in the increased mobility of the testis, possibly negating the need for surgical intervention for the ascending testicle. He recommended an additional 20 hour regime of the manual physical therapy.

Seven months after the first CPA therapy (26 months following the trauma), the patient returned for an additional 20 hours of treatment focused on further decreasing adhesions. Following that therapeutic series, the patient again showed an apparent decrease of adhesions evidenced by improvement in range of motion (Table 2); improved myofascial, visceral and ligamentous mobility; decreases in pelvic and abdomen pain; decreases in left lower extremity pain and edema; and an improved gait. Pain and functional levels improved to the point that he reported no pain with bowel movements, increased frequency of bowel movements, and further decrease in the laxatives previously required for proper elimination. Upon further urologic examination, the physician noted that the patient demonstrated additional decreases in the scarring and adhesions in the inguinal area (Figure 1A, B) and the previously ascending left testicle was able to be reduced manually into the upper scrotum (Figure 1C, D). Ten months following the second treatment, his parents reported no surgical intervention for the ascending testicle and no further partial SBOs. Moreover, he was able to return to a normal diet, improving not only his

health but also his return to normal daily activities after the accident. They reported that improvements in the patient's physical ability to

participate in *normal* activities also improved his mental status; he no longer required medication for PTSD associated with the MVA.

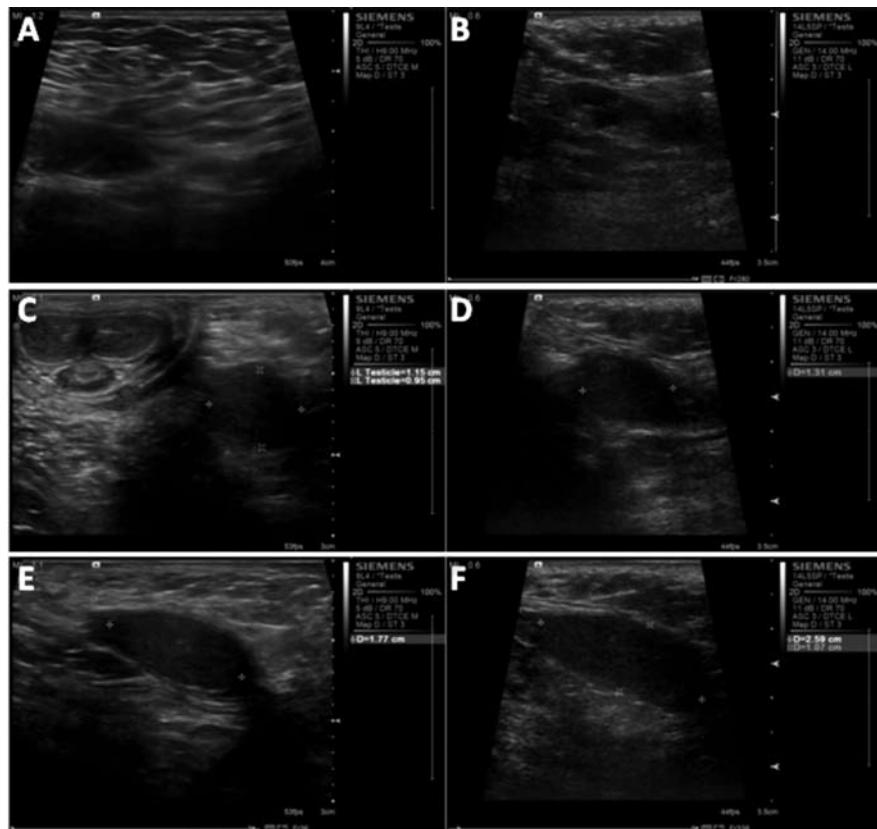


Figure 1. Ultrasound comparison of the scrotum demonstrating improvement in scar formation between the first and second round of treatment. A-B: transverse images of the scrotum. (A) Ultrasound before second round of treatment showing a thickened scrotal wall with complex echogenicity. (B) Ultrasound after the second round of treatment showing improvement in the scrotal wall and echogenicity. C-D: Transverse ultrasound images of the left testicle. (C) Image from before second round of treatment showing testicle located in the inguinal canal, surrounded by scar tissue with complex echogenicity. (D) Image from after the second round of treatment showing the testicle located farther down in the inguinal canal with less scar tissue demonstrating complex echogenicity surrounding the testicle. E-F: Longitudinal ultrasound images of the left testicle. The surrounding tissue of the testicle after treatment (E) is decreased in complexity as compared to before the second round of treatment (F).

Table 2. Range of motion measurements demonstrating improvements in tests identified as not within normal limits at the initial evaluation.

Test, Measure (normal)	Initial (pre treatment)		Discharge (post treatment)		Re-evaluation (pre- treatment II)		Discharge (post treatment II)	
	Left	Right	Left	Right	Left	Right	Left	Right
Hip, Internal rotation (40)	30	40	40	40	30	40	45	40
Hip, Single leg raise (90)	60	80	75	80	65	80	80	80
Trunk, Side bending (45)	30	40	40	45	40	40	50	50
Trunk, Rotation (45)	20	15	30	35	30	35	35	35
Cervical, Extension (45)*	35	-	45	-	45	-	45	-
Cervical, Side bending (45)	30	40	45	45	45	45	45	45
Cervical, Rotation (80)	60	60	70	70	70	70	80	80

*Single measure only.

Discussion

This case report presented the use of a site-specific manual physical therapy focused on the decrease of adhesions to promote the healing and return to normal daily activities in a child that received severe traumatic injuries and post-surgical adhesions as a result of a major pedestrian *versus* vehicle accident. Prior to therapy, the patient had undergone 19 surgeries in the course of 12 months secondary to the accident and had developed severe adhesions at the sites of the trauma and the surgical scars. The degree of adhesion formation was likely compounded by the requirement of the negative pressure wound dressing (VAC),¹⁶ due to the extensive internal injuries and daily surgical intervention. Use of the VAC has been linked to increased levels of adhesions when used for more than 7 days,¹⁷ this patient had VAC for 12 days, therefore the level of scarring and numbers of adhesions was not unexpected.

The patient had utilized traditional physical therapy to strengthen and re-train his body to walk and improve his ability to perform daily activities prior to undergoing CPA treatment. We believe the manual therapy complemented his earlier therapy by decreasing the post-traumatic and post-surgical adhesions, aiding this patient's ability to walk with an improved gait, and to participate in activities that were important to him but that he could not achieve prior to CPA therapy. Thus, the therapy significantly improved his quality of life and opened opportunities for a more normal and functional childhood, and future life. He recently participated in a multiple day long distance bike ride and a camping trip, which was not possible prior to CPA treatment.

This is the first report in the literature of the use of manual physical therapy in a pediatric patient involved in a pedestrian MVA trauma to treat the adhesion related complications from the trauma and subsequent surgeries. This is also the first report of non-surgical physical therapy treatment of a testicle that had ascended out of the scrotum and into the inguinal canal due to scarring and adhesions.

Because the patient was a young child when he was injured, it is expected he will require continued treatment throughout puberty and

into early adulthood, particularly during periods of rapid growth. During these times of growth, some scars and adhesions that were not previously symptomatic could become so, causing pain or dysfunction as his body grows and stretches around the adhered areas. The need for interventions to treat adhesions throughout periods of growth in patients injured as children is common, often observed in pediatric skin graft patients.¹⁸ The intervention of this manual physical therapy is less traumatic, does not carry the risks of additional surgery, and provides a positive outcome for the patient. The use of CPA in treating pediatric patients with extensive surgical or trauma induced scarring is currently under investigation.

Conclusions

Given the outcome of this case report it is evident that the use of this manual physical therapy to treat post-surgical complications in pediatric patients to avoid additional surgery is an advisable treatment alternative.

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