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Improving Access to Care for Arkansas Youth Athletes with Sport-Related Concussion: Establishing "Teleconcussion" in Arkansas

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Introduction

Sport-related concussion is a costly and major medical concern in youth sports (McCrory et al., 2013). Emergency department visits for SRC doubled for 8-13 year-olds and increased 200% for 14 to 19 year-olds from 1997 to 2007 (Bakhos, Lockhart, Meyers & Linakis, 2010). The physical, cognitive, emotional, and sleep-related effects of SRC can negatively influence the short and long term health and well being of youth sport athletes. The on-going brain development that occurs during the youth and adolescent years accounts for the longer SRC recovery outcomes in concussed youth (Covassin, Elbin, Harris, Parker & Kontos, 2012; Field, Collins, Lovell & Marron, 2003; Giza & Hovda, 2001). Moreover, the clinical mismanagement that often occurs with youth athletes can lead to long-term academic and health impairments including post-concussion syndrome (PCS) (e.g., persistent headaches, dizziness, memory difficulty, etc.). Chronic PCS negatively impairs the athlete across several domains including: academic, social, and athletic functioning (McCrory et al., 2013). In addition to functional impairment, medical costs from chronic PCS and concussion totaled approximately $12 billion in 2000 (Finkelstein, Corso & Miller, 2006). In order to improve SRC recovery outcomes for youth athletes and reduce costs, proper management of SRC is critical. Improving access to care for youth athletes with SRC is one way to provide early, empirically supported interventions that may mitigate adverse long-term health and academic outcomes.

Several barriers exist to improving the standard of care and healthcare delivery for youth sport athletes with SRC. It is well documented that youth sport and recreation leagues lack appropriate medical oversight (Meehan, Taylor & Proctor, 2011). Therefore, the identification of SRC is often the responsibility of the coach/volunteer and/or the youth athlete's caregiver. Heightened media attention and increased educational programming for youth sport and recreation leagues have increased awareness of SRC among patients, coaches and officials. Physicians are referring an increasing number of patients to sport concussion specialists for additional follow-up treatment (Kinnaman, Mannix, Comstock & Meehan, 2014). However, many rural areas lack medical professionals with specialized training in SRC. The shortage of appropriate medical providers is problematic, particularly given the consensus recommendation that youth sport athletes with SRC should be managed by a medical professional specializing in SRC (McCrory et al., 2013). New clinics (UAMS/ACH Centers for Children's Concussion Clinic) specializing in the management and treatment of SRC have been established in the Northwest Arkansas region. While these specialty clinics offer a comprehensive and cutting-edge approach to the management of SRC, their ability to reach and treat underserved areas (i.e., rural and urban) of Arkansas is limited. Innovative methods for providing specialized healthcare to youth athletes with SRC are needed.

Telehealth may be an effective means of providing specialized care for youth athletes with SRC located in underserved areas that have a shortage of healthcare providers specializing in SRC. Several studies have demonstrated the effectiveness and feasibility of telehealth in the state of Arkansas (Lowery, Bronstein, Benton & Fletcher, 2014). Specifically, telehealth in Arkansas has been an effective healthcare delivery mechanism and continued education tool for women's health including obstetrical care (Lowery, Bronstein, McGhee, Ott, Reece & Mays, 2007), pediatrics (Gonzalez-Espada, Hall-Barrow, Hall, Burke & Smith, 2009), mental health (Castro, Taylor & Golden, 2011; Fortney et al., 2007) and stroke (Yaghi, Hinduja & Bianchi, 2012). Similar to traditional mental health consultations, the components of an in-depth clinical interview for SRC is conducted by a patient-practitioner interview accompanied with objective computer-based neurocognitive assessment and other objective tests (e.g., vestibular, balance, oculomotor). Information gathered from the clinical visit is reviewed with the patient and their caregiver. A management plan is developed (e.g., academic accommodation, vestibular therapy) and reviewed with the patient in a conversational clinical interview format. The conversational nature of the standard clinical interview for SRC may be feasible for telehealth. However, researchers have yet to conduct a study comparing differences in the therapeutic alliance and patient satisfaction among telehealth and in-office consultations. The therapeutic alliance measures the relationship and emotional connection the child/youth athlete has with the therapist (Shirk, Karver & Brown, 2011). A meta-analysis by Shirk and Karver (2003) reveled that the patient-therapist relationship is related to treatment outcome. Vargas, Channer, Dodick, and Demaerschalk, (2012) published the only study to date on this topic- a case study demonstrating the feasibility of telehealth for the clinical assessment of a rural-student athlete with SRC. While this study represents a first step toward using telehealth for SRC, additional research examining differences in the therapeutic alliance and patient satisfaction between telehealth and in-office visits is warranted (Kutcher et al., 2013).

“Teleconcussion” may be a viable alternative for eliminating geographical (urban, rural) barriers for access to appropriate healthcare for SRC. However, the current infrastructure for telehealth services in Arkansas has yet to be used for SRC, and the efficacy of teleconcussion compared to the traditional face-to-face SRC evaluation is unknown. Implementing a teleconcussion network among medical providers across the state and creating an infrastructure for specialty referral will increase access to healthcare for youth athletes with SRC. As a result, youth athletes with SRC will receive specialized care that will enable them to experience expedited recoveries and minimize chronic recoveries- leading to improved healthcare outcomes and safe return to play management in an at-risk population. Arkansas teleconcussion would be among the first to implement such a healthcare delivery program in the US. The current preliminary investigation will compare patient, caregiver, and provider ratings of the therapeutic alliance and clinical visit satisfaction scores between telehealth and in-office consultations for youth athletes with SRC.

Review of Literature

Sport-related concussion (SRC) continues to garner more attention from the media. The latest consensus statement defines concussion as a "complex pathophysiological process affecting the brain, induced by biomechanical forces" (McCrory et al., 2013). Understanding the biomechanical forces acting on the brain and the internal cascade that follows will help better understand the process of the injury and how to spot the signs and symptoms and better assess and manage the concussion.

Prevalence of Sport-Related Concussion

The amount of youth athletes participating in sports creates a concern about the effects of concussion (McCrea, Hammeke, Olsen, Leo & Guskiewicz, 2004). Langlois and colleagues (2006) estimate that 1.6-3.8 million SRC occur annually and this estimate could be low because of underreporting of injuries. In a study by McCrea and colleagues (2004), of the student athletes who reported sustaining a concussion during the season, 52.7% failed to notify a coach, parent or athletic trainer. Underreporting of concussions could be due to a variety of reasons, including not wanting to lose playing time, letting teammates down, not thinking the injury was serious enough, not having the knowledge of the signs of concussion and the potential consequences and not wanting to leave the current game (McCrea et al., 2004). Underreporting or masking symptoms by an athlete makes a concussion diagnosis harder and increases the chances of a non-diagnosis and further injury (McCrea et al., 2004).

A study by Gessel et al. (2007), found that 8.9% of all injuries in nine high school sports were concussions, with the majority (65.4%) occurring during a game. The researchers calculated a concussion injury rate of .23 concussions per 1000 athletic exposures (A-Es) for practice and games combined. Games produced a high concussion rate (.53 concussions per 1000 A-Es) compared to .11 concussions per 1000 A-Es in practice. An athletic exposure was defined as 1 player's participation in a practice or game and an injury was defined as occurring during practice or a game that requires attention by the athletic trainer or physician and results in a limitation of participation in the practice/game for any amount of days. The majority of concussions occurred in football, followed by girl's soccer, boy's soccer and girl's basketball (Gessel et al., 2007). In sports played by both boys and girls, girl sports had higher rates of concussion (Gessel et al., 2007).

Biomechanics of Sport-Related Concussion

Understanding the biomechanics of concussion can seem daunting because there are many different motions the head can do when it is struck or when it strikes a surface and each impact can be unique (Meaney & Smith, 2011). However, for all impacts there are contact and acceleration forces that act upon the brain (Meaney & Smith, 2011). Contact forces are generally associated with skull fractures and not concussions (Meaney & Smith, 2011). Acceleration/deceleration of the brain is the primary cause of a concussion (Meaney & Smith, 2011).

Concussion is caused by linear and rotational acceleration/deceleration of the head. Linear acceleration produces pressure gradients and rotational acceleration produces rotation of the skull while the brain remains stationary (Unterharnscheidt, 1972). Many studies to date have studied these accelerations to better understand the biomechanics of concussions.

Studies on linear acceleration attempted to find an injury threshold (Meaney & Smith, 2011). This injury threshold has been studied by recording the pressure inside the brain during an impact. The sudden increase in intracranial pressure may be from the acceleration due to impact (Thomas, Roberts, & Gurdjian, 1966). There is a strong correlation between the linear acceleration and pressure inside the brain (Meaney & Smith, 2011). Rotational acceleration is associated with shear forces and these forces cause tissue damage (Meaney & Smith, 2011). These accelerations of the head and brain are the biomechanics that lead to the underlying pathophysiology that occurs inside the brain.

Pathophysiology of Sport-Related Concussion

Concussion deficits rarely are observable on imaging scans because they tend to be functional disturbances, not structural (McCrory et al., 2013). The combination of absence of changes to neuroimaging scans and the resolution of normal brain activity with time, suggests that the brain cells are not dying, but are temporarily dysfunctional (Giza and Hovda, 2001). The underlying dysfunction can be caused by shifts in the ionic balance, changes in the metabolism of the cells, impaired communication between the cells or changes in neurotransmission (Giza and Hovda, 2001). This "neurochemical cascade" occurs immediately after head impact and continues for a period of time (MacFarlane and Glenn, 2015).

After an impact that causes movement of the brain there is an immediate release of neurotransmitters and ionic fluxes (Giza and Hovda, 2001). An excitatory neurotransmitter, glutamate, is released and when it attaches to NMDA receptors the cells will depolarize further causing an ionic shift, calcium goes into the cell and potassium leaves the cell. The ionic shift leads to alterations in the physiology of the cell. To repolarize the cell, the Na+-K+ pump becomes increasingly active, which means it needs an increasing amount of ATP. Increases in the demand for ATP leads to increased glucose metabolism. Increasing the glucose demand of the brain cells, when the cells are not receiving enough blood flow (not getting enough glucose supply) leads to an energy crisis in the brain. The flux of calcium into the cells can disrupt the connectivity of the neurons within the brain. This internal cascade of events lead to a variety of apparent signs and outward and inward symptoms that are associated with SRC.

Signs and Symptoms of Sport-Related Concussion

While there are many signs and symptoms associated with concussions, not every youth athlete will experience all of them, as each concussion can present uniquely.

In high school athletes the most commonly reported symptoms are headaches, dizziness and confusion (Gessel et al., 2007). On-field signs include loss of consciousness, amnesia, balance difficulties and dizziness (Lau, Kontos, Collins, Mucha & Lovell, 2011). Confusion, rather than loss of consciousness, is the more common form of cognitive changes following a concussion (Collins et al, 2012). Other symptoms common to concussive injuries are disorientation, unsteadiness, loss of consciousness and visual disturbances (Giza and

Hovda, 2001). Symptoms of most concussions resolve within 7-10 days (McCrory et al., 2013; Vagnozzi et al., 2010). Signs and symptoms play an important role in return to play (RTP) assessment. Athletes must be symptom free at every stage of the RTP protocol and have a full return of cognitive function (Lau et al., 2011).

Assessment and Management of Sport-Related Concussion/Challenges to Providing Care

In order to make a concussion diagnosis, specific assessments are performed, including assessments of clinical symptoms, physical signs, cognitive impairment, neurobehavioral features and sleep disturbances (McCrory et al., 2013). When a youth athlete shows any of the signs and symptoms listed above, a physician or a licensed healthcare provider should complete a sideline evaluation. A widely used sideline clinical assessment is the Sport Concussion Assessment Tool 3 (SCAT3), which measures clinical symptoms and cognitive functions (McCrory et al., 2013). For many youth athletes, who don't have sideline medical oversight, their first step is a visit to their primary care physician, who often doesn't have the expertise in these injuries (Meehan et al., 2011). The medical assessment conducted at the primary care physician's office or the emergency room is comprised of a neurological examination including cognitive functioning and balance/gait assessment (McCrory et al., 2013). These physicians may call for neuroimaging scans. Diagnostic imaging may be conducted to rule out other brain injuries (McCrory et al., 2013). When neuropsychological testing is necessary, it is recommended that a neuropsychologist carry it out because they are the most qualified at interpreting the tests (McCrory et al., 2013). This neuropsychological testing, which includes cognitive functioning assessments, can be used as an aid in RTP protocol (McCrory et al., 2013). The most commonly used neuropsychological test reported by physicians in a survey was

Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) (Kinnaman et al., 2013). In order to manage a concussion, it is imperative to get physical and cognitive rest and neuropsychological testing can be helpful in the planning of academic accommodations for the youth athlete (McCrory et al., 2013). RTP protocol follows a graded stepwise progression (McCrory et al., 2013). In order to progress, the athlete has to complete the previous step while asymptomatic and each step generally lasts 24 hours; therefore, the full protocol should take at least 1 week (McCrory et al., 2013). For youth athletes, RTP shouldn't occur until the youth has returned to school (McCrory et al., 2013). In addition to the academic accommodations, a more conservative RTP protocol is suggested for youth athletes (McCrory et al., 2013).

Sideline evaluations and emergency room visits are not meant to replace in-depth neuropsychological testing, which should be completed by a trained neuropsychologist, a specialist in concussion (McCrory et al., 2013). Players are more likely to report a potential concussive injury to an athletic trainer rather than to a coach, parent, or teammate (McCrea et al., 2004). Leading to the increased need for medical supervision, in the form of an athletic trainer, on the sidelines of youth sport events. The consensus is to have a specialized clinician to manage concussions and the challenge is that there are a limited number of these qualified specialists to oversee concussions throughout the country. Access to these specialists is difficult to come by in rural communities and requires a large amount of travel. One way to overcome the shortage of SRC specialists in rural communities is to implement the usage of telehealth, a form of videoconferencing, to link these youth athletes to the specialists without the burden of travel.

Telehealth

In recent years, the consensus for concussion management states that professionals specially trained in concussions should be managing these injuries. However, there is a disconnect from the majority of the population and these specialists based on a number of reasons, most commonly geographical distance. Several previous studies have successfully utilized telehealth as a successful method of delivery of a clinical visit as determined from patient satisfaction.

A study by Bishop, O'Reilly, Maddox and Hutchinson (2002) compared patient satisfaction between videoconferencing and face-to-face psychiatric visits. The researchers hypothesized that the satisfaction results would be comparable between the videoconferencing group patients and the face-to-face group patients. The participants were randomly assigned to either the face-to-face visit or the videoconferencing visit for their initial visit and any follow-up visits they might need. The same psychiatrist provided all the visits and all the visits occurred at the same hospital. The participants in the videoconferencing group saw the psychiatrist via a previously established telepsychiatry link. Four months after the initial visit a satisfaction survey was sent out to the participants.

A total of 21 patients were seen initially, 11 in the face-to-face and 10 in the videoconferencing. The mean score on the survey for the face-to-face group was 25.3, while the mean score for the videoconferencing group was 21.6. Although, the participants were more satisfied with the face-to-face visit, the differences were not statistically significant. These data suggest that based on patient satisfaction, telehealth could be an option used to treat individuals with psychiatric issues. The psychiatric clinical consultation shares similar features of the neuropsychological evaluation for SRC.

In a pilot-project from Denmark, a researcher aimed to improve the access to culturally appropriate health care providers by matching clinicians to the participants' ethnic and cultural background and measuring this effect on patient satisfaction (Mucic, 2010). The matching clinician and patient are not always located in the same area, so it would require travel, so the study aimed to eliminate the need for travel by holding the sessions over videoconferencing. The researchers hypothesized high patient satisfaction among the patients who can have their visit via videoconferencing with culturally matched clinicians. There were a total of 61 participants and a total of 318 telepsychiatry sessions. There were 9 different languages spoken during this study. There were 6 clinicians involved who were fluent in either Danish or Swedish and their native language. At the last telepsychiatry session, the patients were asked to complete a 10-item questionnaire that had been translated into their primary language, on patient satisfaction. This survey would be filled out either when they left the treatment center or at their own house.

Of the 61 participants, 52 filled out the questionnaires for an 85% response rate. The participants indicated that the more they came in for treatment the more satisfied they felt with the videoconferencing. The study found that patients reported not having to travel to reach a clinician with their primary language as a major advantage of using videoconferencing. The study concluded that the indicators of patient satisfaction were the accessibility of the clinicians in their primary language, ability to convey thoughts without a 3rd party present, confidentiality of the service, picture and sound quality, not needing to travel, willingness to use telepsychiatry, willingness to recommend telepsychiatry to others, and preference of using telepsychiatry as opposed to an interpreter.

A challenge facing the healthcare system is getting access to specialists to the rural communities, where the ratio of specialists to general physicians is 1:12 (Davis, Coleman, Harnar & King, 2014). Many Veterans live in these rural areas and need access to neurology specialists. The Veterans Affairs (VA) has started to develop community-based outpatient clinics (CBOCs) in rural areas (Bloch, 2010). Primary care physicians staff these CBOCs so there is still a need to get specialists to these centers and having the specialists drive long distances was inefficient; therefore, the VA developed telehealth programs. The clinical video telehealth system allows the Veterans to have access to the neurologist. The clinician was able to do a cranial nerve exam and look at pupil symmetry and presence of nystagmus. There was also a motor evaluation that tested gross motor movement. At the end of the session the participant was asked to fill out a performance improvement satisfaction questionnaire. Eighty-nine percent of the participants who completed the survey said that the teleneurology visit was more convenient than travelling to Albuquerque. Full satisfaction occurred in 90% of the participants and only 3% were dissatisfied. Ninety-five percent said that they would continue with teleneurology for their subsequent follow-up visits. The study concluded that teleneurology could only conduct a limited neurologic examination; so seeing patients face-to-face for the initial examination was necessary. In conclusion, the authors state the participants were satisfied with their teleneurology visit.

The previous studies have all indicated that patient satisfaction for clinical visits via videoconferencing is high. Bishop and colleagues (2002) indicated that the satisfaction of the visit increases with the number of visits, suggesting that patients using videoconferencing may take some time to fully adjust and become comfortable with the clinician. The final study suggests that follow-up visits via teleneurology were appropriate for most Veterans living in rural communities and that while the follow-up examination was limited, it did not affect the treatment outcomes for the Veterans (Davis et al., 2014). Since patient satisfaction was high for the use of videoconferencing for psychiatric and neurologic settings, telehealth could be a viable option for SRC diagnosis and management.

Methods

Research Design: A between-subjects design was used.

Participants: Eighteen patients with confirmed concussion (13-17 years) and their accompanying caregivers (e.g., parent/guardian) seeking care at the UAMS/ACH Concussion Clinic were enrolled in the study. The UAMS/ACH Concussion Clinic requires that all patients have a caregiver accompany them to their visit; therefore, only patients with at least one accompanying and consenting caregiver were included in the study. In addition, the treating clinician also participated in the study and provided corresponding ratings of provider satisfaction of the clinical visit.

Measures/Instrumentation:

Demographics: Demographic data including age, sex, race/ethnicity, concussion history, on-field injury details (mechanism of injury and on-field signs of concussion), and time since injury to current clinical visit were gathered.

Therapeutic Alliance: The Therapeutic Alliance Scale for Children- Revised (TASC-R) (Creed & Kendall, 2005; Shirk, Karver & Brown, 2011) is a 12-item Likert scale (1- not true; 4- very much true). This scale has demonstrated good reliability and validity. (Creed & Kendall, 2005) The Therapeutic Alliance Scale for Caregivers and Parents (TASCP) is a 12-item Likert scale that is completed by the caregiver that assesses the caregiver-therapist alliance (Accurso, Hawley & Garland, 2013). These scales were administered in both in-office and telehealth conditions.

Satisfaction Scales: The current study will gather three satisfaction ratings on: 1) Session Satisfaction, 2) Satisfaction of Neuropsychological Evaluation, and 3) Satisfaction with the clinical setting (e.g., Traditional/In-Office versus Videoconferencing/Telehealth).

1. <u>Session Satisfaction-</u> The Session Evaluation Questionnaire- Form 5 (SEQ) (Stiles & Snow, 1984) was completed by the patient and assesses overall satisfaction for the clinical visit. This scale assesses two dimensions of the patient's postsession mood: positivity and arousal. The SEQ is comprised of 21 opposite adjective scales that are presented in a 7-point semantic differential format. This scale has reported good internal consistency with alphas ranging from .78 to .91 (Stiles & Snow, 1984). This scale was completed in both in-office and telehealth conditions.
2. <u>Satisfaction of Videoconferencing/Telehealth Clinical Setting or Satisfaction with Traditional/In-Office Clinical Setting-</u> This survey is adapted from Parikh et al., (2013) and assesses satisfaction and preferences for completing neuropsychological testing between the in-office and videoconferencing settings. This scale was modified for the in-office and telehealth conditions for this study and these two versions were given to the parent, patient, and clinician. The Traditional/In-Office Clinical Setting survey had 14-items an the Videoconferencing/Telehealth Clinical Setting questionnaire had 15-items. Ratings on the 5-point Likert scale were totaled for an outcome score.

Procedure: The study has current IRB approval at UAMS/ACH and UofA FAY. Each patient and their accompanying caregiver were recruited and enrolled in the study upon arriving for their first clinical visit at the concussion clinic. Patients and their caregivers were randomly assigned to the traditional in-office visit (*n*= 9) or a "mock" Telehealth visit (n=9).

During the in-office clinical visit the patient and their caregiver saw the clinician in the same room and all clinical care were delivered in-office. The "mock" Telehealth visit required the patient and caregiver to sit in a designated patient room in the same clinic equipped with telehealth technology. The clinician conducted the clinical visit via videoconferencing in another room at the clinic. At the conclusion of the visit, all patients completed the TASC-R, and SEQ-5, and the caregiver completed the TASCP. In addition, the patient, caregiver, and clinician completed the Satisfaction with the Videoconferencing/Telehealth Clinical Setting questionnaire for the telehealth visit, while for the in-office visit they completed the Satisfaction with the Traditional/In-Office Clinical Setting questionnaire (See Table 1). All patient and caregiver pairs were compensated $50.00. Only one payment was made for each patient/caregiver "pair" for participation.

Table 1. Overview of measures for the in-office and telehealth visit conditions.

	In-Office			Telehealth		
	Parent	Patient	Clinician	Parent	Patient	Clinician
Satisfaction with Traditional/In-Office Clinical Setting Questionnaire	✔	✔	✔			
Satisfaction with Videoconferencing/Telehealth in the Clinical Setting Questionnaire				✔	✔	✔
TASCP	✔			✔		
SEQ		✔			✔	
TASC-R		✔			✔	

Data Analysis: Descriptive statistics was used to describe the sample. Means comparisons (e.g., independent samples t-tests and analysis of variance) were employed to assess differences on the all survey totals among the telehealth and in-office visits. Statistical significance was set at $p \leq .05$.

Results

Demographics

There were a total of 18 patients (*M* = 14.81*, SD* = .91 years) that participated in the study along with their accompanying parent/guardian and the treating clinician. Nine patients (*M* = 14.79, *SD* = 1.33 years) and their parent/guardian were randomly assigned to the telehealth and nine patients and their parent/guardian were randomly assigned the traditional face-to-face visit (*M* = 14.89*, SD* = 1.11 years). Patients for the telehealth visit were comprised of six males and three females, and the face-to-face visit was comprised of eight males and one female. The clinician that participated in the study was also male.

Satisfaction with the Clinical Setting

The Satisfaction with the Clinical Setting questionnaire was completed by at the end of the visit. All items were scored on a Likert scale (1 = extremely disagree, 5 = extremely agree). A 2 condition (face-to-face, telehealth) X 3 group (patient, parent, clinician) between-groups analysis of variance (ANOVA) was conducted on the first item of the scale ("Overall, I was satisfied with the face-to-face/videoconference testing session"). The results of this analysis revealed a significant between-subjects effect for condition (F [1,53] = 4.78, p =.03, η^2 = .09) and group (F [2,53] = 5.47, p =.007, η^2 = .19). Post-hoc analyses revealed that face-to-face condition rated their overall satisfaction with testing session significantly higher than the telehealth group (p = .03). The clinician rating of the satisfaction was significantly lower than the parent rating (p = .006). The means and standard deviations for these items among the patient, parent, and clinician across the two conditions are presented in Table 2.

Table 2. Means and standard deviations for items on the Satisfaction with the Clinical Setting Questionnaire. Items are derived from a 5-point Likert scale.

	Face-to-Face						Telehealth					
Item	Patient		Parent		Clinician		Patient		Parent		Clinician	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1. Overall, I was satisfied with the face-to-face /videoconference testing session.	4.67	.50	5.00	.00	4.33	.71	4.44	.73	4.56	.73	4.0	.00
2. I felt comfortable with the in-office/videoconference testing session.	4.67	.50	4.75	.70	4.78	.44	4.33	.87	4.56	.73	3.89	.33
*3. I was not concerned about my privacy during testing.**	4.78	.44	4.89	.33	5.0	.00	4.67	.71	4.78	.44	4.89	.33
4. The testing instructions were easy to understand.	4.22	.83	4.78	.67	4.89	.33	4.22	.97	4.67	.50	4.22	.44
5. I would recommend in-office/videoconferencing-based cognitive testing to others.	4.22	.83	4.89	.33	4.67	.50	3.78	1.09	4.33	.71	4.22	.44
6. It was easy to establish a personal connection with the examiner.	4.33	.87	4.78	.44	4.56	.73	4.22	.83	4.56	.73	4.00	.50
7. It was easy to communicate with the examiner.	4.44	.73	4.89	.33	4.22	.67	4.44	.73	4.56	.53	4.00	.50
*8. It was easy for me to manipulate the testing materials.**	4.44	.88	4.33	1.32	4.89	.33	4.22	.97	4.67	.50	4.11	.33
9. It was easy to hear the examiner.	4.56	.73	4.89	.33	4.89	.33	4.67	.71	4.67	.71	4.33	.50
10. It was easy to see the examiner.	4.67	.71	4.89	.33	4.89	.33	4.11	.93	4.67	.71	4.33	.50
11. I was not anxious/nervous during the testing session.	4.11	1.27	4.33	1.12	4.33	.50	4.11	1.17	4.67	.71	4.00	.00
*12. It was easy to concentrate during the testing session.**	4.22	.67	4.44	.73	4.44	.73	3.89	.78	4.44	.88	4.11	.33
13. The testing session was interesting and/or fun.	3.67	.71	4.67	.71	4.33	.71	4.33	.71	4.44	.73	3.89	.60

Note: * For the parent questionnaire, answers were based on their child

Session Evaluation (SEQ-5)

The Session Evaluation Questionnaire- Form 5 was completed by the patient in both the face-to-face visit and the telehealth visit. All items were scored on a range from 1 to 7. The results of an independent samples t-test analysis showed significant differences for difficult-easy (p = .02), weak-powerful (p = .03) and happy-sad (p = .05), with patients reporting higher positive evaluations (easy, powerful and happy) in the telehealth group compared to the face-to-face group. The means and standard deviations for those items among the patients across both visit conditions are presented in Table 3.

Table 3. Means and standard deviations for items on the SEQ- Form 5. Items were scored on a range from 1-7.

	Face-to-Face		Telehealth		
Item	Patient		Patient		
	M	*SD*	*M*	*SD*	*p*
This Session Was:					
(1) Bad - Good (7)	6.00	1.00	6.67	.71	.12
(1) Difficult - Easy (7)	4.89	1.45	6.33	.71	.02
(1) Valuable - Worthless (7)	2.89	2.09	2.33	1.73	.55
(1) Shallow - Deep (7)	4.78	1.30	5.44	1.24	.28
(1) Relaxed - Tense (7)	2.78	2.05	2.11	1.17	.41
(1) Unpleasant – Pleasant (7)	5.67	1.66	6.22	.67	.37
(1) Full – Empty (7)	2.33	1.41	2.00	1.00	.57
(1) Weak – Powerful (7)	4.78	1.20	6.00	.87	.03
(1) Special – Ordinary (7)	4.00	1.66	3.67	1.58	.67
(1) Rough – Smooth (7)	5.56	1.24	6.13	.83	.29
(1) Comfortable – Uncomfortable (7)	2.44	1.94	1.89	.93	.45
Right Now I Feel:					
(1) Happy – Sad (7)	3.56	1.59	2.11	1.27	.05
(1) Angry – Pleased (7)	5.89	1.05	6.11	1.05	.66
(1) Moving – Still (7)	3.89	1.69	4.44	2.19	.56
(1) Uncertain – Definite (7)	5.11	1.05	5.78	1.09	.21
(1) Calm – Excited (7)	3.78	1.64	3.22	1.64	.48
(1) Confident – Afraid (7)	2.89	1.36	2.67	1.22	.72
(1) Friendly – Unfriendly (7)	2.78	1.56	2.00	.87	.21
(1) Slow – Fast (7)	4.11	2.09	4.11	1.62	1.00
(1) Energetic – Peaceful (7)	4.67	2.35	4.78	1.30	.90
(1) Quiet – Aroused (7)	2.67	1.87	3.00	1.32	.67

Therapeutic Alliance

The results from a independent samples t-test for total score on the TASC-R between patients in the telehealth (*M* = 33.56, *SD* = 2.60) and face-to-face conditions (*M* = 32.00, *SD* = 3.20) revealed no significant differences between the groups (t (16) = -1.13, *p*=.28). In addition, parents in the telehealth group (*M* = 32.00, *SD* = 1.85) did not differ on the TASCP total score compared to the parents in the face-to-face group (*M* = 31.75, *SD* = 2.31) (t (14) = -.24, *p*=.82).

Discussion

The purpose of the current study was to compare patient, parent/guardian and clinician satisfaction ratings between 2 conditions, telehealth and in-office clinical visits and the therapeutic alliance formed between the clinician and the patient and the clinician and the guardian. A noteworthy finding of this study was participants (patients and parents and clinicians) in the in-office group rated their overall satisfaction of the testing session significantly higher than participants in the telehealth group (*p* = .03). Another important finding was that the clinician rating of the clinical visit setting satisfaction was significantly lower than the corresponding rating the parent/guardian provided (*p* = .006). These post-hoc tests show that the patients, parents and clinicians are more comfortable and satisfied with the traditional face-to-face clinical visit.

The ratings on the therapeutic alliance were not significantly different between patients in the in-office and the telehealth conditions (*p* = -1.13), which shows that creation of the relationship between the clinician and the patient was not influenced by the different mode of viewing the clinician. The patient viewed the relationship with the clinician similar, regardless if it was over videoconferencing technologies or face-to-face. The therapeutic alliance for children has been shown to be a valid and reliable measure of the emotional connection the patient has with their clinician (Shirk, Karver & Brown, 2011). The finding from this study is a first step showing that the same feelings of an emotional connection can be formed over videoconferencing technologies. Ratings on the corresponding survey for caregivers, the TASCP, did not differ between the telehealth and the in-office conditions ($p = .82$), which means that parents also viewed the relationship that was created with the clinician to be beneficial even when the clinical visit occurred over videoconferencing technologies.

The utilization of telehealth technologies for concussion evaluations in Arkansas is still in the first stages of implementation. Even so, many of the results from the current study support findings from previous studies. Satisfaction ratings from the clinician in this study were lower than the ratings from the other participants. In a study on the implementation of videoconferencing technologies for pediatric surgery, clinicians also reported lower satisfaction ratings than the patients (Shivji, Metcalfe, Khan & Bratu, 2011). The lower levels of satisfaction could be due to the changes in daily routines and the usage of new technologies (Whitten & Love, 2005). A meta-analysis on the therapeutic alliance indicated that this relationship is related to the outcomes of pediatric treatment. (Shirk and Karver, 2003). The current study showed that this alliance could be created over videoconferencing; therefore, further longitudinal studies are needed to show a relationship with outcome measures and videoconferencing usage. Differences between the results of the current study and literature include the significant effect of the visit condition on the ratings of satisfaction of the clinical visit. The literature suggests a high level of patient satisfaction with clinical visits or high ratings on the therapeutic alliance via videoconferencing (Backhaus et al., 2012; Becevic, Boren, Mutrux, Shah, Banerjee, 2015; Davis, Coleman, Harnar & King, 2014; Morgan et al., 2014; Simpson and Reid, 2014). Satisfaction of psychiatric visits via videoconferencing has been shown to be comparable to satisfaction of visits via traditional visit settings (Bishop, O'Reilly, Maddox & Hutchinson, 2002); however, the current study shows significant differences in overall satisfaction between the telehealth and in-office conditions. Drawing generalizations from the current study should be limited because of the small sample size and a singular clinician providing all the clinical visits.

Limitations of this study include a small sample size (n=18), subject bias, carryover effect from the multiple surveys, and progressive effects with the comfort levels with videoconferencing technologies for the clinician. This study is the first step in implementing teleconcussion in Arkansas and more participants are needed. Since all the participants were self-reporting and wanting to seem like a 'good subject,' a form of subject bias, they could be influenced to respond in a way that would cause them to be viewed favorably. Progressive effects could affect the clinician by becoming more comfortable with the videoconferencing technologies the more initial clinical visits that occurred using the technologies. Possible carryover effects could influence the responses on the multiple surveys since there was no counterbalancing of the order of the surveys. The next step would be to increase the sample size and create randomized orders of the surveys create counterbalancing. Further research, including longitudinal outcome measures of teleconcussion, and larger sample sizes for patient, parent and clinician satisfaction ratings, is needed to better understand the feasibility of implementing telehealth for SRC management in Arkansas.

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