

Polish Academy of Sciences · Poznan Division
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Rehasport Clinic Foundation – Poznan

Polska Akademia Nauk · Oddział w Poznaniu
Komisja Rehabilitacji i Integracji Społecznej
Fundacja Rehasport Clinic – Poznań

**Issues of Rehabilitation, Orthopaedics,
Neurophysiology and Sport Promotion – IRONS**
**Zeszyty Promocji Rehabilitacji, Ortopedii,
Neurofizjologii i Sportu – IRONS**

(formerly Issues of Rehabilitation Promotion)
(dawniej Zeszyty Promocji Rehabilitacji)

A Quarterly Published Scientific Journal
Kwartalnik Naukowy

Founded in 2012
Rok założenia 2012

Vol 47
June 2024
Czerwiec 2024
ISSN 2300-0767

www.ironsjournal.org

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Fundacja Rehasport Clinic, ul. Górecka 30, 60-201 Poznań

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The journal is indexed in The Index Copernicus – 98.6, old Ministry of Science and Higher Education score – 6 points (2015), new Ministry of Science and Higher Education score – 20 points (2019), and Polish Medical Bibliography databases.

The official Journal of Polish Shoulder and Elbow Society.

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CONTENT

ORIGINAL ARTICLE

Comparative analysis of selected combined therapy treatments with standard management in back pain during a sanatorium stay

Michał Ulikowski
Jacek Lewandowski 7

Evaluation of intra- and interobserver reliability in the assessment of alpha angle in femoroacetabular impingement syndrome (FAI)

Antoni Raciborski Król
Jakub Wąsik
Tomasz Noras
Katarzyna Kwas
Radosław Grabowski
Marcin Domżański 17

Reliability of scapular morphology assessment using mixed reality

Szymon Stupnicki
Mikołaj Zakryś
Bartosz Gołembiewski
Stanisław Kommissarczyk
Jan Klincewicz
Anna Maria Kubicka
Bartłomiej Lubiowski
Przemysław Lubiowski 25

REVIEW ARTICLES

Advocacy in shoulder surgery: the american perspective

Brandon DuBose Bushnell 31

My path as an orthopedic surgeon: tips and tricks for junior doctors

Brandon DuBose Bushnell
Emily R. Leonard PA-C
Ashley G. McEver PA-C
Robert Baudier OPA, ATC 41

SPIS TREŚCI

PRACA ORYGINALNA

Analiza porównawcza wybranych zabiegów terapii skojarzonej z postępowaniem standardowym w bólach kręgosłupa podczas pobytu sanatoryjnego

Michał Ulikowski
Jacek Lewandowski 7

Ocena wiarygodności wewnątrz- i międzyobserwacyjnej w ocenie kąta alfa w konflikcie udowo-panewkowym (FAI)

Antoni Raciborski Król
Jakub Wąsik
Tomasz Noras
Katarzyna Kwas
Radosław Grabowski
Marcin Domżański 17

Rzetelność narzędzi mieszanej rzeczywistości w ocenie morfologii łopatki

Szymon Stupnicki
Mikołaj Zakryś
Bartosz Gołembiewski
Stanisław Kommissarczyk
Jan Klincewicz
Anna Maria Kubicka
Bartłomiej Lubiowski
Przemysław Lubiowski 25

ARTYKUŁY POGLĄDOWE

Orędownictwo w chirurgii barku: perspektywa amerykańska

Brandon DuBose Bushnell 31

Moja droga jako chirurga ortopedy: wskazówki i triki dla młodych lekarzy

Brandon DuBose Bushnell
Emily R. Leonard PA-C
Ashley G. McEver PA-C
Robert Baudier OPA, ATC 41

5TH MEETING OF THE POLISH
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51

5-TE SPOTKANIE POLSKIEGO
TOWARZYSTWA BARKU I ŁOKCIA 17-TY
MIĘDZYNARODOWY POZNAŃSKI KURS
CHIRURGII KOŃCZYNY GÓRNEJ –
BARK, ŁOKIEĆ, POZNAŃ, POLSKA,
27-29 MARCA 2025 R.

51

ORIGINAL ARTICLE

COMPARATIVE ANALYSIS OF SELECTED COMBINED THERAPY TREATMENTS WITH STANDARD MANAGEMENT IN BACK PAIN DURING A SANATORIUM STAY

ANALIZA PORÓWNAWCZA WYBRANYCH ZABIEGÓW TERAPII SKOJARZONEJ Z POSTĘPOWANIEM STANDARDOWYM W BÓLACH KRĘGOSŁUPA PODCZAS POBYTU SANATORYJNEGO

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A – Research concept and design

B – Collection and/or assembly of data

C – Data analysis and interpretation

D – Writing the article

E – Critical revision of the article

F – Final approval of the article

ABSTRACT

Introduction

Spinal pain can affect the spine as a whole or its individual segments. Lumbar and sacroiliac pain affects about 70% of the world's population, making it have become a disease of civilization, leading to long-term limitations in human functioning or disability.

Aim

The purpose of the conducted research is the effectiveness of selected combined therapy procedures during sanatorium treatment in patients with pain in the lumbosacral-sacral spine, their impact on the patients' performance and quality of life.

Material and methods

The study was conducted at the Ministry of Interior and Administration rehabilitation medical facility in Kolobrzeg among sanatorium patients participating in 21-day stays in the period from July 2019 to September 2022. The study included 100 patients diagnosed with nonspecific lower back pain syndrome. Patients were randomly divided into two groups of 50. All calculations were performed using STATISTICA 8 to find out if the quality of sanatorium treatment differed according to the treatments selected. The results of the experimental group (combined therapy) were compared with the results of the control group, taking into account pain intensity and assessment of functional capacity. Changes in the level of dependent variables were monitored by two measurements, performed on the same subjects before and after treatment.

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Authors reported no source of funding
Authors declared no conflict of interest

Date received: 13th December 2024

Date accepted: 20th December 2024

Results

Based on the analysis of the obtained results, it can be concluded that all methods of sanatorium treatment lead to an improvement in the studied parameters, but the use of combined therapy allows to achieve a better therapeutic effect.

Conclusions

Combined therapy is an effective method of treating lumbosacral spine pain in a sanatorium stay. Combined therapy treatments have shown better therapeutic effects than standard sanatorium treatment offered by the National Health Fund. Combined therapy has the effect of increasing patients' functional status.

Keywords: combined therapy, spine dysfunction treatment, sanatorium, rehabilitation

STRESZCZENIE

Wstęp

Bóle kręgosłupa mogą dotyczyć jego całości bądź poszczególnych jego odcinków. Bóle odcinka lędźwiowo – krzyżowego dotyczą ok 70% światowej populacji, przez co stały się chorobą cywilizacyjną, prowadzącą do długotrwałych ograniczeń w funkcjonowaniu człowieka, czy jego niepełnosprawności.

Cel

Celem prowadzonych badań jest skuteczności wybranych zabiegów terapii skojarzonej podczas leczenia sanatoryjnego u pacjentów z bólem w odcinku lędźwiowo-krzyżowym kręgosłupa, ich wpływ na sprawność oraz jakość życia pacjentów.

Materiał i metody

Badania przeprowadzone zostały w Sanatorium MSWiA w Kołobrzegu wśród pacjentów sanatoryjnych uczestniczących w turnusach 21-dniowych, w okresie od lipca 2019 r. do września 2022r. Badaniami objęto 100 osób, u których rozpoznano niespecyficzny zespół bólowy dolnego odcinka kręgosłupa. Pacjenci losowo zostali podzieleni na dwie grupy 50-cio osobowe. Wszystkie obliczenia wykonano w programie STATISTICA 8 celem sprawdzenia, czy jakość leczenia sanatoryjnego różni się w zależności od dobieranych zabiegów. Porównywano wyniki grupy eksperymentalnej (terapia skojarzona) z wynikami grupy kontrolnej, uwzględniając nasilenie bólu oraz ocenę sprawności funkcjonalnej. Zmiany w poziomie zmiennych zależnych monitorowano w ramach dwóch pomiarów, wykonywanych u tych samych badanych przed podjęciem i po zakończeniu leczenia.

Wyniki

Na podstawie analizy otrzymanych wyników można stwierdzić, że wszystkie metody leczenia sanatoryjnego prowadzą do poprawy badanych parametrów, jednak zastosowanie terapii skojarzonej pozwala osiągnąć lepszy efekt terapeutyczny.

Wnioski

Terapia skojarzona jest skuteczną metodą leczenia dolegliwości bólowych w odcinku lędźwiowo-krzyżowym kręgosłupa w warunkach pobytu sanatoryjnego. Zabiegi terapii skojarzonej wykazały lepsze efekty terapeutyczne niż standardowe leczenie sanatoryjne oferowane przez NFZ. Terapia skojarzona ma wpływ na zwiększenie stanu funkcjonalnego pacjentów.

Słowa kluczowe: terapia skojarzona, leczenie schorzeń kręgosłupa, sanatorium, rehabilitacja

Introduction

Chronic low back pain (CLBP) is a widespread public health problem. Epidemiological data show that lower back pathology affects more than 570 million people worldwide (Wu *et al.*, 2020), of which approximately 85%–95% of patients have no specific pathoanatomical cause for their pain (Finucane *et al.*, 2020). The occurrence of CLBP carries a number of socioeconomic disadvantages that impinge on the condition of society as well as the country as a whole. CLBP-related disability, resulting sick leave, and loss of an employee create additional costs not only for the patient himself, but also for the employer and the treasury (Flitz and Firat, 2019).

The factors that can trigger the occurrence of CLBP are numerous, making it difficult to accurately determine the cause of its formation and effective and sustainable treatment management (Overas *et al.*, 2020). This has forced the World Health Organization (WHO) to publish the latest guidelines for the therapeutic and rehabilitative management of in spinal pain syndromes, in which spa treatment fits perfectly (Romanowski *et al.*, 2019).

Comprehensive physiotherapy management is aimed at reducing pain, restoring normal range of motion of the spine, and proper stabilization of the spine to prevent overloading of the skeletal and muscular systems (Plaskiewicz *et al.* 2015). A holistic therapeutic approach to the patient ensures improved functional capacity, which enables the satisfaction of basic and complex life needs, which are determinants of autonomy and autarky (Wiktor *et al.* 2010).

Combined therapy involves the simultaneous application of two or more therapeutic stimuli, which triggers a synergistic effect increasing the effectiveness of therapy with a reduced total treatment time, as well as improving the comfort of the procedure performed. The choice of the type and types of combined therapy treatments is selected

individually to the patient, taking into account the patient's functional status, the type and severity of pathology, previous treatment and the expected effects and benefits of the methods used (Ponikowska, 2017). The goal of combining physical treatments in combined therapy is to achieve a distant, long-term, adaptive change in the body that will last for a longer period of time and lead to improved health (Allen, 2006).

AIM

The purpose of the conducted research was to evaluate the effectiveness of selected combined therapy treatments in patients with lumbosacral spine pain and their impact on the functional performance of the patients.

The study formulated the following research hypotheses (H):

H1. Combined therapy is an effective method of treating chronic lumbosacral spine pain in a sanatorium setting.

H2. The effectiveness of the therapeutic program depends on the type of spa therapy used.

H3. Combined therapy improves the functional capacity of patients.

Material and methods

The study was conducted at the Ministry of Interior and Administration rehabilitation medical facility in Kolobrzeg among sanatorium patients aged 50–70 years who had chronic lumbosacral spine pain of degenerative etiology and/or overload, participating in 21-day stays from July 2019 to September 2022. Eligibility for the study, was confirmed by physicians, referral to spa treatment and results of follow-up examinations (physical, subject and ancillary X-ray, MRI, CT). The study included 100 patients diagnosed with nonspecific lower back pain syndrome. Patients were randomly divided into two groups of 50.

Group I consisted of 30 women (age $X = 62.80$; $SD = 5.62$) and 20 men (age $X = 62.58$; $SD = 5.12$). Most of them were residents of rural areas ($N = 31$) who, also used pain medications ($N = 35$) and physiotherapy treatments ($N = 28$), and had been struggling with lower back pain for more than 16 years ($X = 16.86$; $SD = 5.52$). Group II included 32 women aged $X = 63.38$ ($SD = 6.13$) and 18 men aged $X = 61.83$ ($SD = 5.49$). Among the women, the majority were residents of urban areas ($N = 21$), while among the men, the majority lived in rural areas ($N = 11$). Women struggled with the disease for an average of 16 years ($X = 16.34$), while men took 17 ($X = 17.33$). Pain medications were used by 39 patients (25 women, 14 men), and physiotherapy treatments were used by 30 patients (23 women, 7 men).

Group I (the study group) received treatments in the form of combined therapy type 2 including the principles of safety, performance methodology and selection of energy forms (Pasek *et al.*, 2017). The package included TENS + ultrasound combination therapy (11 treatments), mud iontophoresis (11 treatments), saline pool gymnastics (11 treatments), hydromassage with salt water (11 treatments), Aqua Thermo Jet (10 treatments). Group II (NFZ) received the following treatment package: short-wave diathermy DKF (8 treatments), group gymnastics (9 treatments), mud packs (10 treatments), brine baths (10 treatments), Nemeo interference currents (8 treatments), classical massage of the spine (9 treatments).

A comprehensive evaluation of the subjects was performed twice: on the day of admission to the sanatorium stay and on the day of completion of the therapeutic stay (the period covers 21 days). The Numerical Rating Scale (NRS) recommended by the Polish Association for the Study of Pain and the modified Pain Rating Scale according to Domzhal were used to assess pain intensity. Patients' functional status was assessed using the Lower Back Pain Rating Scale (LBPRS scale), which allows us to consider the degree of functional impairment based on fifteen

types of physical activity (Radziszewski, 2006, Polish Association for the Study of Pain, 2018).

All calculations were performed in STATISTICA 8 to find out, whether the quality of sanatorium treatment differed according to the treatments selected. The results of the group treated with combined therapy were compared with the results of the group treated according to NHF recommendations, taking into account the severity of pain and assessment of functional capacity.

In any research process, there are limitations that should be taken into account by researchers. In the present research, the most important limitation is the size of each group. An important aspect is the time span of the experiment conducted. The rather long time span of the study, covering different seasons, may have affected the physiological characteristics of the body, physical activity and lifestyle of the patients. All of the above factors could have affected the effect of the treatment, as well as the perceived effects of the therapy. The last limitation is the measurement methodology. Pain, as a subjective assessment of the patient, can take on different values. The same level of pain, some patients may describe as severe, others as moderate, and still others as very severe, which affects the the results and quality of therapy effects.

Results

Significant reductions in lumbosacral spine pain, as measured by the NRS scale, were noted between the first and second measurements ($p < 0.05$), but the combined therapy treatment group had significantly lower levels of pain than the standard treatment group ($p < 0.05$) (Figure 1.).

There was a significant reduction in perceived pain in the Domzhal scale in the lumbosacral spine between the first and second measurements ($p < 0.05$). The mean values of lumbosacral spine pain at the end of the study differed between groups I and II. There was a significantly lower level of pain

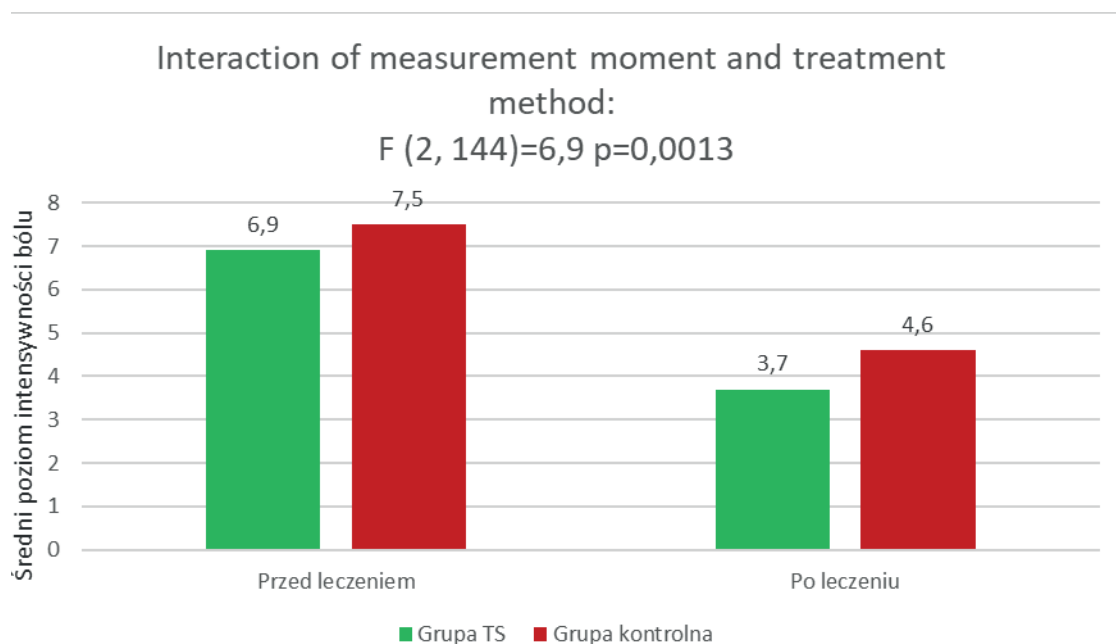


Figure 1. Pain intensity on the NRS scale

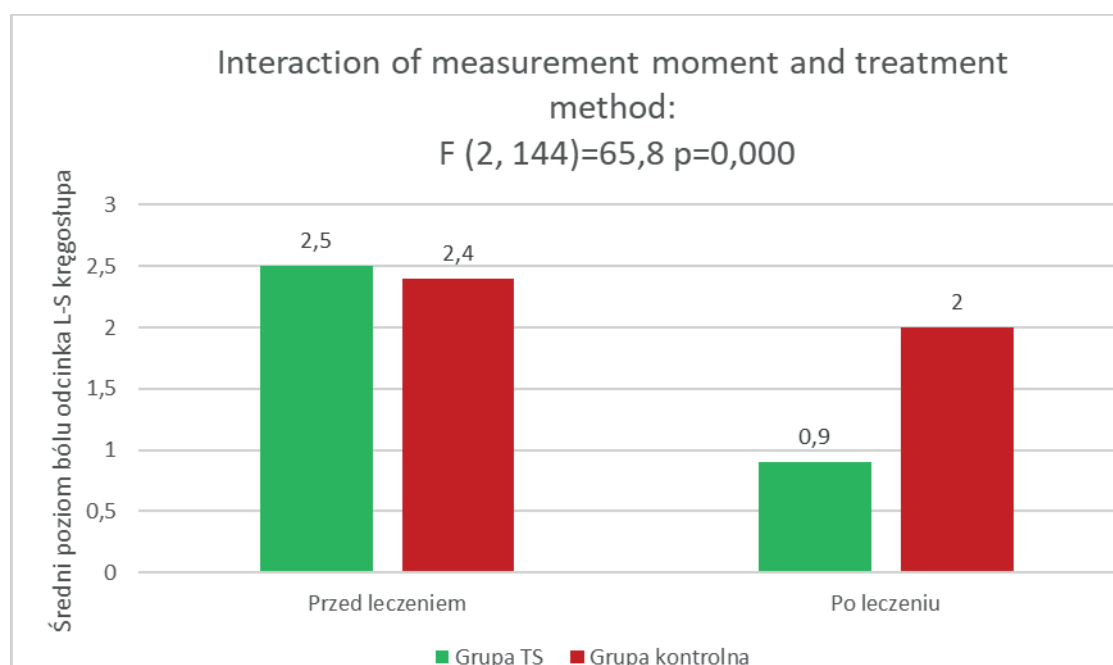


Figure 2. Pain intensity on the Domzal scale

in the study group than in the control group ($p < 0.05$). (Figure 2).

In the functional assessment of patients in each group, there was a significant reduction in functional disability between the first and second examinations ($p < 0.05$). The mean functional impairment at the end of the study differed between the groups. A significantly

lower level of functional impairment was observed in the combined therapy group than in the group with standard medical treatment ($p < 0.05$) (Figure 3).

Discussion

Our own study confirmed the effectiveness and validity of combined therapy as part of

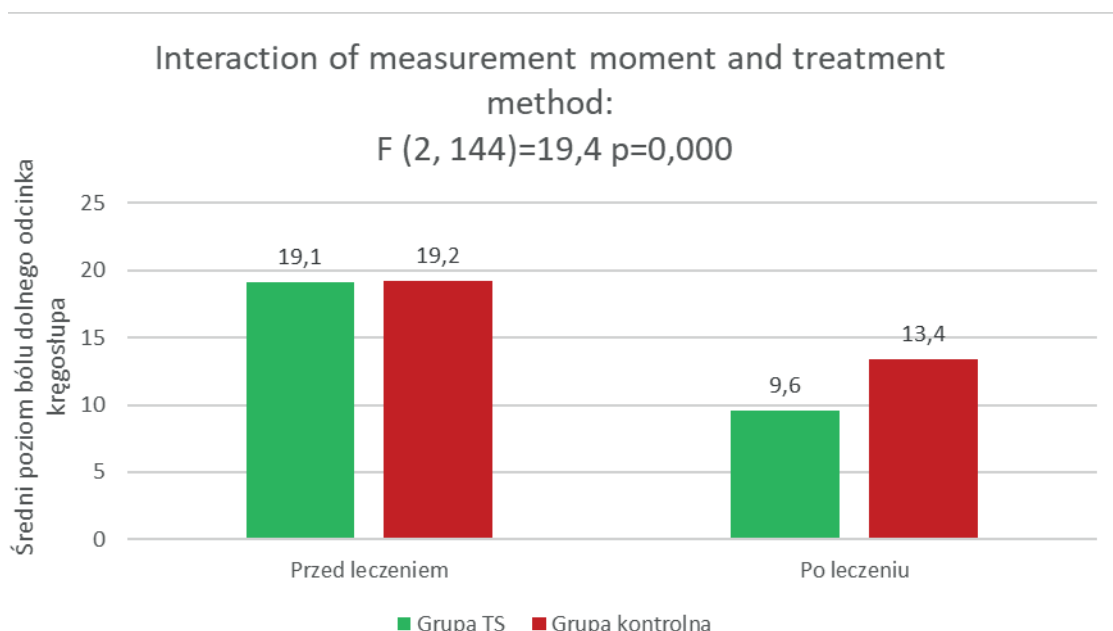


Figure 3. Assessment of the patient's functional status according to the LBPRS

the sanatorium treatment of lumbosacral spine pain. The results of the therapy assessing the intensity of pain and the functional capacity of the patients apologizes that the applied treatment was effective in each of the studied groups. The final therapeutic effect was significantly more favorable in the group with combined therapy, compared to the group with standard treatment.

Kolu *et al.* performed a comparative analysis of the effects of high-intensity laser therapy with combined therapy with TENS currents and ultrasound, on the analgesic outcome and functionality of patients with chronic lumbar radiculopathy. The 54 patients studied were divided into two groups. In group I, treatments included mud packs, combined therapy of TENS currents and ultrasound, and kinesiotherapy exercises. In group II, treatment included high-energy laser treatments, a mud pack and kinesiotherapy exercises. Patients were evaluated using the visual analog scale VAS and Oswestry Disability Index (ODI), before treatment, at the end of therapy, and four weeks after the end of treatment. The results of the study show better therapeutic effects immediately after the end of treatment, as well as one month later in the group with combined

treatment of TENS currents with ultrasound, both in pain levels and in the ODI disability index (Kolu *et al.*, 2018). Our own research confirms the effectiveness of combination therapy and its superiority over the conventional use of physical therapy.

Similar findings were submitted by Dilekçi *et al.* They conducted a study on the effectiveness of combined balneology and physical therapy in patients with chronic nonspecific low back pain, in the treatment of pain, functional disability and their impact on patients' quality of life. They compared the results of 129 patients treated with hot mud packs, electrostimulation with TENS currents and ultrasound therapy, with a combined therapy group of 133 patients, which additionally benefited from balneological treatments in the form of a pool of thermomineralized water. The effects of the therapy were analyzed using the VAS visual analog scale, the Roland-Morris Disability Questionnaire and the Quebec Back Pain Disability Scale (QBPDS) at the beginning and end of the treatment. After the end of treatment, there was a significant decrease in all variables in favor of combined therapy. VAS and disability scale scores on the RMDQ questionnaire were at the $p < 0.01$ level of significance, while for

the QBPDS scale they were at the $p < 0.05$ level (Dilekçi *et al.*, 2020).

The effectiveness of combined therapy in the treatment of lumbosacral pain was documented in the work of Kim *et al.* They studied the therapeutic effect of two different combinations of combined therapy in the treatment of lower back pain. They divided the 40 patients they studied into two, 20-person groups. Group I received a heat massage, using the CGM MB – 1401 device, which simultaneously applied acupuncture, moxibustion therapy, spinal rubbing and heat. Group II received a combined physiotherapy program that consisted of ultrasound therapy, TENS transcutaneous electrical nerve stimulation and a hot pack. The analgesic effect of the therapy was evaluated using: Numerical Pain Scale (NRS) and McGill pain questionnaire. Functional assessment of patients was performed with questionnaires: the Oswestry Disability Index (ODI) and the Roland-Morris Disability Questionnaire (RMDQ). The results of the therapy were evaluated before the clinical trial, after two weeks and after four weeks of therapy. The analgesic effect of therapy was noted at the second and fourth weeks of treatment in both groups. Functional disability scores also improved in both groups, after two and after four weeks compared to the results before the start of therapy. There was no significant difference after and during treatment between the groups (Kim *et al.*, 2023). Kim's research confirms the results obtained in this study as to the effectiveness of using combination therapy to treat lower back pain.

Ozkaraoglu *et al.* studied the effectiveness of high-frequency laser therapy (HILT) and transcutaneous TENS nerve electrostimulation in combination with other treatments on pain intensity, functional disability and improvement in spinal range of motion. The patients, aged 18 to 60 years, were assigned to 2 groups. The first group received ultrasound therapy, TENS transcutaneous nerve electrostimulation and a mud pack. The second group was treated with ultrasound, high-energy

laser and a mud pack. The effects of therapy were measured using the VAS pain scale and the Oswestry questionnaire. Spinal mobility was measured using a goniometer. Deliberating the results of the study, there was a significant improvement in all parameters studied in both groups. The results measured by the VAS scale showed a significant difference in favor of the group treated with ultrasound therapy, TENS percutaneous nerve electrostimulation and hot pack, while in the measurement of range of motion and functional disability there was no statistical difference between the study groups (Ozkaraoglu *et al.*, 2021). The conclusions put forward by Ozkaraoglu coincide with the results of our own study.

Evidence of the therapeutic efficacy of combined therapy is provided by a paper that aimed to compare the short-term efficacy of three electrotherapeutic methods in relieving root pain caused by lumbar intervertebral disc herniation by Efrat *et al.* (2022). Fourteen patients with root pain participated in one electrotherapy session, which included four 10-minute treatments: transcutaneous electrical nerve stimulation (TENS), interferential stimulation (IF), combined treatment with pulsed ultrasound and IF current (CTPI), and sham control. The degree of straight leg raising (SLR) was measured immediately before and after each treatment. After treatment, the most visible improvement was observed with CTPI treatment, followed by IF and finally TENS. Sham stimulation did not affect SLR results.

The effectiveness of using combined therapy to treat back pain was studied by Yilmaz *et al.* (2020). The purpose of their study was to compare the effects of high-intensity laser therapy (HILT) and a combination of transcutaneous nerve stimulation (TENS) and ultrasound (US) treatment on pain, range of motion (ROM) and functional activity in neck pain associated with cervical spine disc herniation (CDH). A total of 40 patients suffering from CDH participated in the study and were randomly divided into two groups. In Group 1 (20 patients), patients received 20

sessions of HILT plus exercise, while Group 2 (20 patients) received a combination of US, TENS and exercise. The results of the therapy were measured by the range of motion of the cervical spine, pain level measured by the Visual Analog Scale (VAS) and functional activity measured by the Neck Pain and Disability Scale (NPADS) before and after therapy. After treatment, all measured parameters improved significantly in both groups ($p < 0.05$), and there was no statistical significance between the two groups ($p > 0.05$). Both therapies showed analgesic efficacy and improved function in patients affected by CDH after four weeks of treatment. The results obtained by Yilmaz *et al.* are not consistent with the results of our own study. The reasons for this may be too small group sizes, a small treatment area or poorly selected therapeutic doses.

A study to compare the effects of high-intensity laser therapy (HILT) and a combination of ultrasound (US) and transcutaneous nerve stimulation (TENS) treatment on pain, range of motion (ROM) and functional activity in patients with cervical spondylosis (CS) was conducted by Venosa *et al.* (2018). A total of 84 patients affected by CS participated in the study. Patients were randomly divided into two groups: A (42 patients) who received 12 sessions of HILT plus exercise; B (42 patients) treated with a combination of US, TENS and exercise. The effects of therapy were measured by the range of motion of the cervical segment, the level of pain measured by the Visual Analog Scale (VAS) and functional activity measured by the Neck Disability Index (NDI) at the end of therapy. In both groups, cervical range of motion, VAS and functional scores showed significant changes, with better results in participants enrolled in Group A (HILT plus exercise). These results contradict, not only the results obtained by Yilmaz *et al.* but also our own.

The effectiveness of using combined therapy to treat knee osteoarthritis (KOA) was demonstrated by Usman *et al.* (2019). Their study aimed to compare the effects of

combined ultrasound and infrared interferential current therapy on pain, functional activities and quality of life in people with KOA. They divided the subjects into two groups. Group I treated with CT and group II treated with infrared lamp light. Each group received 15-minute treatment three times a week for 12 weeks. The Visual Analog Scale (VAS), the Osteoarthritis Index (WOMAC) and a health status questionnaire form were used to assess pain to determine quality of life. At the end of the study, a significant ($p < 0.05$) reduction in pain and a significant ($p < 0.05$) improvement in functional activity and quality of life were observed in patients treated with combined therapy.

Alqualo-Costa *et al.* demonstrated the higher efficacy of using combined therapy to treat knee osteoarthritis than with monotherapy. They randomly assigned patients to four groups with the following therapies: interferential current, photobiomodulation, interferential current plus photobiomodulation, and a placebo-treated group. They measured pain intensity at rest and during movement as the main outcome. Patients were evaluated at the beginning of the study, after 12 sessions, and three and six months after treatment. Their results show that interferential current plus photobiomodulation reduced pain intensity at rest and during movement compared to placebo and interferential current at all time points (Alqualo-Costa *et al.* 2021).

Conclusions

The obtained results of our own study, as well as the results of other authors' studies detailed in the discussion, allow us to affirm that the use of combined therapy in the treatment of non-specific lumbosacral spine pain, affects better pain degeneration and functional improvement of patients suffering from spinal pain.

Combined therapy is an effective method of treating painful conditions in the lumbosacral spine in a sanatorium setting. Combined therapy treatments showed better therapeutic

effects than standard sanatorium treatment offered by the National Health Fund. Combined therapy has the effect of increasing the functional status of patients.

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ORIGINAL ARTICLE

EVALUATION OF INTRA- AND INTEROBSERVER RELIABILITY IN THE ASSESSMENT OF ALPHA ANGLE IN FEMOROACETABULAR IMPINGEMENT SYNDROME (FAI)

OCENA WIARYGODNOŚCI WEWNĄTRZ- I MIĘDZYOBSERWACYJNEJ W OCENIE KĄTA ALFA W KONFLIKCIE UDOWO-PANEWKOWYM (FAI)

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A – Research concept and design

B – Collection and/or assembly of data

C – Data analysis and interpretation

D – Writing the article

E – Critical revision of the article

F – Final approval of the article

ABSTRACT

Introduction

Femoroacetabular Impingement Syndrome (FAI) is a multifactorial hip disorder that originates from abnormal contact between the femoral head-neck and the acetabulum, ultimately leading to joint damage. The most precise definition of FAI, established in 2016, describes the condition as a motion-related hip disorder characterised by pain symptoms, restricted mobility and characteristic imaging findings. FAI manifests in three main morphological types: Cam, where bone growth on the femur causes abnormal head-neck offset, Pincer, where the acetabulum excessively covers the femoral head and Mixed which contains features of both previous mentioned types. The alpha angle is a key radiographic measure used to diagnose Cam-morphology FAI. However, studies have demonstrated that there is considerable variability in the reliability of its measurement, with intraobserver reliability typically higher than interobserver consistency.

Aim

The aim of the study was to determine variability of alpha angle measurements on radiographs, with use of the inter- and interobserver reliability in assessing the alpha angle of the hip joint.

Material and methods

A retrospective observational study was conducted on 72 radiographs of adult patients diagnosed with FAI who had undergone arthroscopic osteoplasty of the hip joint. The patients' axial radiographs were evaluated by three independent investigators. Measurements were taken preoperatively and postoperatively in two probes before and after the blinding process was initiated.

Results

Value of Inter-Observer Reliability of alpha angle measurements in preoperative group (0.44–0.62) as well as in postoperative group (0.48–0.50) is moderate. Value of intra class reliability come with significant variability, as is lower in postoperative group (0.46–0.89) and higher in postoperative group (0.79–0.96).

Conclusions

Constituency of measurements of alpha angle might be influenced by lack of observer's experience.

Keywords: femoroacetabular impingement syndrome, alpha angle, hip arthroscopy

STRESZCZENIE

Wprowadzenie

Konflikt udowo-panewkowy (ang. Femoroacetabular Impingement Syndrome, FAI) jest wieloczynnikowym schorzeniem stawu biodrowego. Charakteryzującą się objawami bólowymi, ograniczoną ruchomością i charakterystycznymi wynikami badań obrazowych. FAI objawia się w trzech głównych typach morfologicznych: Cam, gdzie wzrost kości na kości udowej powoduje nieprawidłowy kontakt między głową a szyjką, Pincer, gdzie panewka nadmiernie pokrywa głowę kości udowej i Mieszany, który zawiera cechy obu poprzednich wymienionych typów. Kąt alfa jest kluczową miarą radiograficzną stosowaną do diagnozowania FAI o morfologii Cam. Badania wykazały jednak, że istnieje znaczna zmienność w wiarygodności jego pomiaru, przy czym wiarygodność wewnątrzobserwacyjna jest zwykle wyższa niż spójność międzyobserwacyjna.

Cel badania

Celem badania było określenie zmienności pomiarów kąta alfa na radiogramach, z wykorzystaniem wiarygodności wewnątrz- i międzyklasowej w ocenie kąta alfa w stawie biodrowego.

Materiał i metody

Retrospektywne badanie obserwacyjne przeprowadzono na 72 osiowych radiogramach dorosłych pacjentów ze zdiagnozowaną FAI, którzy przeszli artroskopową osteoplastykę stawu biodrowego. Pomiary wykonano przed i po operacją, w dwóch próbach przed i po zaślepieniu.

Wyniki

Wartość wiarygodności międzyklasowej pomiarów kąta alfa w grupie przedoperacyjnej (0,44–0,62), jak również w grupie pooperacyjnej (0,48–0,50) jest umiarkowana. Wartość wiarygodności wewnątrzklasowej charakteryzuje się znaczną zmiennością, ponieważ jest niższa w grupie pooperacyjnej (0,46- 0,89) i wyższa w grupie pooperacyjnej (0,79–0,96).

Wnioski

Na zgodność pomiarów kąta alfa może mieć wpływ brak doświadczenia obserwatora.

Słowa kluczowe: konflikt udowo-panewkowy, kąt alfa, artroskopia biodra

Introduction

Femoroacetabular Impingement Syndrome (FAI) is likely multifactorial femoral head-neck deformity which leads to the abnormal contact between the proximal femur and the acetabulum and progressive chondrolabral injury (Grantham and Philippon, 2019). The precise aetiology remains uncertain.

The most accurate definition of FAI was published in the Warwick Consensus in 2016, which described FAI as a “motion-related clinical disorder of the hip with a triad of symptoms, clinical signs, and imaging findings.” It represents symptomatic premature contact between the proximal femur and the acetabulum (Griffin *et al.*, 2016) FAI can be divided into two main morphological types: Cam and Pincer. The Cam morphology is characterised by a bone superstructure on the proximal femur, which leads to an abnormal neck-head offset. In contrast, the Pincer morphology is defined by bone over coverage of the femoral head by the acetabulum. A mixed morphology can be observed when characteristic of both impingements are present (Ganz *et al.*, 2003).

In FAI, the alpha angle is a crucial radiographic measure, with studies indicating varying degrees of intra- and interobserver reliability. The alpha angle is defined as the angle formed between two lines, one of which originates at the centre of the femoral head and the other of which leads to the centre of the femoral neck, with the line between them extending to the edge of the acetabulum. The measurement of the alpha angle is of great importance in the diagnosis of Cam- morphology FAI. An increased alpha angle is indicative of a potential deformity.

Clohisy *et al.* highlighted that the reliability of radiographic evaluations of the hip, including the alpha angle, is often limited. It was observed that while intraobserver reliability tends to be higher, interobserver reliability can be significantly lower, reflecting the challenges in consistent measurements across different observers (Clohisy *et al.*, 2009). This observation aligns with findings from Shimodaira research, who reported nearly perfect agreement for

the alpha angle in their study yet acknowledged that other studies have shown lower interobserver reliability compared to intraobserver reliability (Shimodaira *et al.*, 2021). This discrepancy suggests that while individual observers may consistently measure the alpha angle, variability can arise when different observers are involved. Further supporting the reliability of the alpha angle measurement. High reliability is crucial for clinical practice, as it ensures that the measurements can be trusted for diagnostic and treatment decisions.

The primary aim of this study was to assess the interobserver and interobserver variability of alpha angle measurement. The secondary aim was to determine changes in the alpha angle prior to and following hip arthroscopic osteoplasty.

Materials and methods

The group of patients on whom this study was conducted was admitted between 2014 and 2018 to the Department of Orthopaedics and Traumatology in Military Medical Academy Memorial Teaching Hospital of the Medical University of Lodz – Central Veterans’ Hospital. The Inclusion criteria were as follows: adult patients (over 18 years old), diagnosed with FAI Cam or Mixed morphology, qualified for referrals for arthroscopic treatment hip arthroscopic osteoplasty.

Exclusion criteria included prior advanced osteoarthritis or evidence of post-traumatic deformity, Legg-Calve-Perthes disease, osteonecrosis or hip dysplasia, poor quality of radiograph, lack of control photo.

A total of 52 patients (9 females and 43 males), with an average age of 41 years (ranging from 19 to 66), were included in this study. There were 26 hips on the right side and 26 on the left side. From these group 36 cases were assessed both before and after surgical intervention.

Standing axial radiographs were acquired from the hospital’s database of alpha angles in affected sides before and after the surgery with an additional blinded trial.

The blinding was performed by that one of the researchers that did not measure the alpha angle, removed any personal information visible in the photo and changed the title of the photo so as not to suggest whether the radiograph was taken before or after the operation. The radiographs were evaluated by medical students following training in assessment of alpha angle by an experienced orthopaedic surgeon, who also supervised them during data collection. For the assessment of radiographs the RadiAnt DICOM Viewer (URL: <https://www.radiantviewer.com>) and Horos software programs were used. Statistical analysis was performed using the Statistica 13 program.

The alpha angle is defined as the angle between a line drawn in the long axis of the femoral neck and a connecting line in the centre of the femoral head, with the point located where the head loses sphericity. It was measured using an axial pelvic view (Fig. 1). For the purpose of statistical analysis the Intraclass Correlation Coefficient (ICC) and Student's T-test were performed. For A p-value of < 0.05 was considered statistically significant.

Results

Preoperative alpha angle

For Observer 1 all the measurements of alpha angle before surgery showed normal distribution.

The mean alpha angle in a blinded probe was $74.21^\circ \pm 8.527$, whereas in a not blinded series – $72.584^\circ \pm 6.192$.

For Observer 2, a blinded probe presented normal distribution whereas the unblinded probe did not. The mean alpha angle in a blinded probe was $77.697^\circ \pm 6.295$. In not blinded series the median alpha angle was 77.30° .

For Observer 3 all the measurements of alpha angle before surgery showed normal distribution.

The mean preoperative alpha angle in a blinded probe was $72.740^\circ \pm 7.864$. In the not blinded series the mean alpha angle was $73.03^\circ \pm 8.45$.

The analysis revealed that Inter-Observer Reliability of alpha angle measurements for not blinded group before operation was 0.44 and after blinding trial it acquired 0.62 (Table 3.). Intra-Observer Reliability of alpha angle measurements for Observer 1 – 0.46; for Observer 2 – 0.66; for Observer 3 – 0.89 (Table 4.).

Postoperative alpha angle

For Observer 1 all the measurements had normal distribution. The mean alpha in the blinded group angle was $60.72^\circ \pm 8.626$. In the not blinded series the mean alpha angle was $56.32^\circ \pm 6.414$.

The measurements of Observer 2 also showed a normal distribution. The mean alpha angle in the blinded group was $63.83^\circ \pm 8.26$. In the not blinded series the mean alpha angle postsurgically was $62.33^\circ \pm 8.839$.

For Observer 3 the measurements did not acquire normal distribution. The median alpha angle in the blinded group was 53.85° . In the not blinded series, the median alpha angle postsurgically was 56.90° .

The analysis revealed that Inter-Observer Reliability of alpha angle measurements for not blinded group before operation was 0.48 and after blinding trial it acquired 0.50 (Table 3.)

Intra-Observer Reliability of alpha angle measurements for Observer 1 – 0.90; for Observer 2 – 0.79; for Observer 3 – 0.96 (Table 4.).

Discussion

The primary objective of this study was to ascertain the intra- and interobserver reliability of alpha angle measurements, given its critical role in the accurate diagnosis and treatment planning of FAI. The findings revealed that inexperienced observers who are not radiology specialists exhibited moderate interobserver reliability for both preoperative (0.44–0.62) and postoperative measurements (0.48–0.50), as presented in Table 3. The variability of these values was found to range from moderate to excellent, as demonstrated in Table 4. The secondary objective of this study was to observe the changes in the alpha angle following arthroscopic osteoplasty.

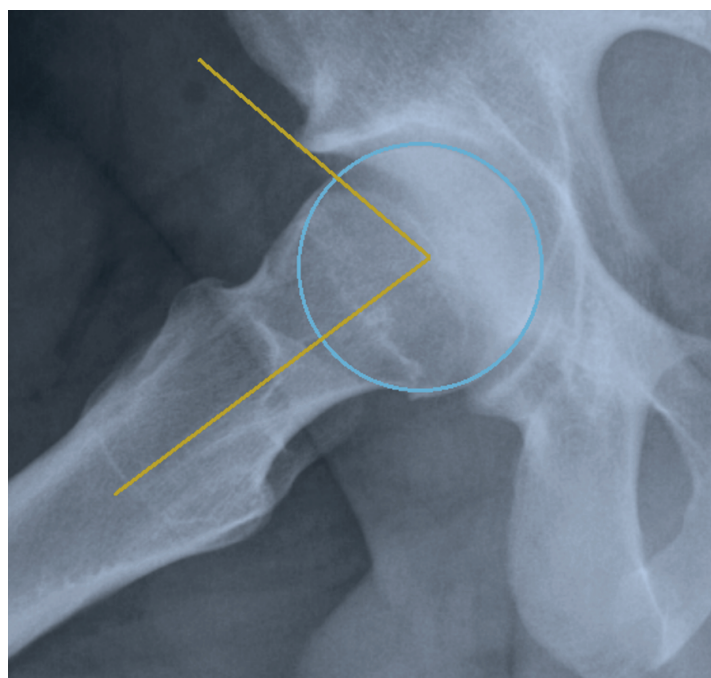


Figure 1. Measurement of alpha angle on radiograph

Table 1. Measurements of the mean/median preoperative alpha angle.

	Blinded	p-value	Not blinded	p-value
1st Observer	74.21° ± 8.527	0.6*	72.584° ± 6.192	0.328*
2nd Observer	77.697° ± 6.295	0.348*	77.10° †	0.011
3rd Observer	72.740° ± 7.864	0.504*	73.03° ± 8.45	0.444*

† – median * – normal distribution

Table 2. Measurements of the mean/median postoperative alpha angle.

	Blinded	p-value	Not blinded	p-value
1st Observer	60.72° ± 8.626	0.6*	56.32° ± 6.414	0.754*
2nd Observer	63.83° ± 8.26	0.505*	62.33° ± 8.839	0.379*
3rd Observer	53.85° †	0.005	56.90° †	0.019

† – median * – normal distribution

Table 3. Value of Inter-Observer Reliability of alpha angle measurements.

Inter-Observer reliability	Preoperative	Postoperative
Not Blinded	0.44	0.48
Blinded	0.62	0.50

Table 4. Value of Intra-Observer Reliability of alpha angle measurements.

Intra-Observer reliability	Preoperative	Postoperative
1st Observer	0.46	0.90
2nd Observer	0.66	0.79
3rd Observer	0.89	0.96

The results obtained from the measurements revealed that the alpha angle values were higher in the postoperative group compared to the preoperative group for each probe.

The reliability of alpha angle can significantly influence clinical outcomes, as variations in interpretation can lead to misdiagnosis or inappropriate treatment strategies. A study by de Sa *et al.* established that an alpha angle greater than 55° is indicative of Cam morphology, reinforcing the importance of accurate measurement (de Sa *et al.*, 2014).

Stähelin *et al.* demonstrated that patients with alpha angle higher than 50° did not differ from those with lower values of alpha angle in terms of clinical outcome measure in the six-months period (Stähelin *et al.*, 2008). Moreover, the study conducted by Philippon *et al.* illustrated that the over a five-year period, there were no differences in patient-related outcomes between groups with postoperative angles greater than 55° and those with alpha angles less than 55°, based on a questionnaire including the modified Harris Hip score (MHHS), WOMAC, HOS ADL, HOS Sport, SF12 and patient satisfaction (Philippon *et al.*, 2007). It is noteworthy that they employed a similar methodology to ours for measuring alpha angle on plane radiographs.

However, the interpretation of the alpha angle can be influenced by the imaging modality used. For instance, while plain radiographs are commonly utilized, advanced imaging techniques such as MRI and CT provide more detailed assessments of hip morphology and may yield different alpha angle measurements (Barton *et al.*, 2011).

Studies have shown that the alpha angle exhibits high intraobserver reliability, with intraclass correlation coefficients (ICCs) often exceeding 0.80, indicating good agreement (Konan, Rayan and Haddad, 2010; Schottel *et al.*, 2014). For instance, it was reported that the ICC for intraobserver reliability of the alpha angle was 0.88, suggesting that experienced radiologists can consistently reproduce their measurements (Konan, Rayan and Haddad, 2010).

This high level of reliability is crucial for clinical practice, as it ensures that a single observer can confidently assess the alpha angle over time without significant variability. On the other hand, a study by Wong *et al.* evaluated hip radiographs and reported poor inter-reader agreement of 0.33 (Wong *et al.*, 2021).

Conversely, interobserver reliability tends to be lower than intraobserver reliability, which is a common finding in radiographic assessments.

What can be observed in paper published by Mast *et al.* on hip radiographs where the alpha angle measurements came with interrater ICC of 0.83 and the intrarater ICC for Observers were 0.98 and 0.96 (Mast *et al.*, 2011). Our results especially that of postoperative group show the same tendency.

Similar results were obtained by Barlow *et al.* in which three independent observers evaluated 50 MRIs of patients complained of hip pain (Barlow *et al.*, 2014). They achieved interrater reliability of 0.67, and obtained better intrarater reliability of 0.84.

For this deduction contract the paper published by Lohan *et al.* in which they concluded that alpha angle has poor intra observer variability between each measurement, up to 30% of mean value (Lohan *et al.*, 2009). The corresponding conclusions were reached in another study. During comparing various methods of measuring radiograph parameters it was observed that alpha angle has moderate interobserver agreement between each probe, ICC ranging from 0.33–0.47 (Carlisle *et al.*, 2011).

However, low value of agreement between each Observer demonstrates that the measurement of the alpha angle may be subjective if taken by inexperienced physicians. Furthermore, evident differences in intraclass before and after surgery shows inconsistency in measurements. Higher intra-class value in postoperative group suggest that it might be easier to find measure alpha angle in postoperative conditions. This discrepancy underscores the importance of standardized measurement protocols and training

for radiologists and orthopaedic surgeons to enhance consistency in alpha angle assessments. Furthermore, a study by Neeple *et al.* corroborated these findings, indicating that qualitative evaluations without quantitative measurements often yield poor reliability (Neeple *et al.*, 2014).

This variability highlights the necessity for clinicians to consider the imaging technique when interpreting alpha angle values.

In the present study, no additional methods were employed to measure the alpha angle beyond those available in the software utilized for the evaluation of radiographs.

An intriguing paper was reported by Lai *et al.*, in which a numerical method was employed to measure the alpha angle with greater accuracy. This involved determining curve fitting of the femoral neck, circle fitting of the femoral head, and the determination of femoral neck axis. The results demonstrate that the inter-rater ICC in radiographs was 0.905 and the intra-rater ICC was 0.892 (Lai *et al.*, 2019).

The use of additional methods in alpha angle measurements was investigated by Bouma *et al.* They compared the three-point and anatomic methods for measuring the alpha angle, which defines the femoral neck axis by connecting the centres of three circles projected over the neck contour. Therefore, in comparison to the anatomic method, the 3-point method had the effect of equalising alpha angle measurement: high values obtained with the anatomic method were lower with the 3-point method, and vice versa for low values (referencing interval was 30–66° and 32–58° for the anatomic and 3-point method, respectively) (Bouma *et al.*, 2014). Furthermore, attempts are being made to automate measurements that demonstrate a high degree of agreement with manual measurements (Faber *et al.*, 2021). The discrepancies in the repeatability of the measurements indicate that drawing conclusions based on a single measurement of the alpha angle may be too generalised. Our study has demonstrated these findings based on conventional methods.

However, it is also necessary to determine whether these results can be replicated using supported or automated methods, which are currently under investigation.

Limitations

Although the study presents an innovative approach to the topic, it is not free from limitations. Firstly, the researchers did not have much experience in assessing radiographs and were supervised by more experienced orthopaedic surgeons. The second limitation was the number of patients and lack of control group due to the fact that only patients treated for FAI were included into the study.

Conclusions

The results indicated that the measurement of the alpha angle is associated with a moderate degree of variability. Inexperienced observers have been observed to demonstrate inconsistent measurement practices with regard to the alpha angle. What is intriguing, the measurements of postoperative alpha angle comes with higher realiability between researchers. Future research should focus on developing standardized protocols and exploring the integration of advanced imaging techniques to further refine the assessment of the alpha angle in clinical practice.

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ORIGINAL ARTICLE

RELIABILITY OF SCAPULAR MORPHOLOGY ASSESSMENT USING MIXED REALITY

RZETELNOŚĆ NARZĘDZI MIESZANEJ RZECZYWISTOŚCI W OCENIE MORFOLOGII ŁOPATKI

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ABSTRACT

Recent advancements in Augmented (AR) and Mixed Reality (MR) have significantly impacted the orthopedic field, with hope of holographic tools to enhance surgical precision. This study explores the reliability of a specifically designed software tool, integrated with HoloLens, for measuring anatomical structures of the shoulder girdle in orthopedic surgery. Forty-two right scapulas were analyzed using CT scans, further converted into 3D models, which were then visualized as holograms and measured through augmented reality tools using the RSQ HOLO system. Three researchers performed measurements on three key distances: Glenoid Height (GH), Glenoid Width (GW), and Scapular Width (SW), across two sessions with a minimum 7-day interval. Statistical analysis using Intraclass Correlation Coefficient (ICC) revealed excellent intra-rater reliability for SW (0.96) and GW (0.91), and good reliability for GH (0.85). Inter-rater reliability also showed promising results, particularly for SW (0.91) and GW (0.78), although GH (0.72) showed moderate agreement. Descriptive statistics indicated minimal measurement differences across all groups, with the majority of differences being under 1 mm. These findings demonstrate holographic assessment of bone morphology is highly reliable, supporting its potential use in preoperative planning and intraoperative navigation. Further studies are needed to evaluate the software's performance in clinical settings and its comparison with physical and CT measurements.

Keywords: mixed reality, measurement tool, orthopedic surgery

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Authors reported no source of funding
Authors declared no conflict of interest

Date received: 30th January 2025
Date accepted: 27th February 2025

STRESZCZENIE

Ostatnie osiągnięcia w dziedzinie Rozszerzonej (AR) i Mieszanej Rzeczywistości (MR) zaczynają wywierać znaczący wpływ na dziedzinę ortopedii, a narzędzia holograficzne dają szansę zwiększenia precyzji chirurgicznej. Celem poniższego badania była ocena rzetelności użycia specyficznego oprogramowania, zintegrowanego z HoloLens, do pomiaru struktur anatomicznych obręczy barkowej w chirurgii ortopedycznej. Przeanalizowano 42 prawych łopatek za pomocą tomografii komputerowej (CT), które następnie przekształcono w modele 3D, wizualizowane jako hologramy i mierzone przy użyciu RSQ HOLO. Trzech badaczy przeprowadziło pomiary trzech kluczowych odległości: Wysokości panewki (GH), Szerokości panewki (GW) oraz Szerokości łopatki (SW), w dwóch sesjach z minimalnym 7-dniowym odstępem. Analiza statystyczna za pomocą Współczynnika Korelacji Wewnętrzklasowej (ICC) wykazała doskonałą niezawodność intra-rater dla SW (0,96) i GW (0,91), oraz dobrą niezawodność dla GH (0,85). Niezawodność inter-rater również wykazała obiecujące wyniki, szczególnie dla SW (0,91) i GW (0,78), choć dla GH (0,72) uzyskano umiarkowaną zgodność. Statystyki opisowe wskazały minimalne różnice pomiarowe wśród wszystkich grup, przy czym większość różnic była mniejsza niż 1 mm. Wyniki te pokazują, że oprogramowanie RSQ HOLO zapewnia dokładne i spójne pomiary, wspierając jego potencjalne zastosowanie w planowaniu przedoperacyjnym oraz nawigacji śródoperacyjnej. Konieczne są dalsze badania, które ocenią wydajność oprogramowania w warunkach klinicznych oraz jego porównanie z pomiarami fizycznymi i CT.

Słowa kluczowe: mieszana rzeczywistość, narzędzie pomiarowe, chirurgia ortopedyczna

Introduction

Advances in technology led to the integration of Augmented Reality (AR) and further Mixed Reality (MR) into the medical field, arousing significant attention in recent years (Gregory *et al.* 2018). Among the vast array of MR headsets available on the market, standing as one of the most promising is the Microsoft HoloLens (Gsaxner *et al.* 2023). With this device, one can visualize 3D models as holographic representations (created in advance and based on the patient's preoperative CT images) and interact with them (e.g. rotate in multiple planes, obtain measurements) in real-time environments, such as the operating theater.

Although holographic technology can be considered as relatively new, its potential to increase surgical precision, improve preoperative planning, and aid in intraoperative decision-making has been widely explored across various fields of medicine. Orthopedic surgery is one of these, where spatial understanding of a patient's anatomy and

pathology is crucial for successful outcomes (Lubiatowski 2016, Chytas and Nikolaou 2021, Lubiatowski *et al.* 2021, Brzózka *et al.* 2022, Wawrzyniak *et al.* 2022). We know very well that three dimensional imaging is more resistant to experience in evaluation of shoulder structures (Kubicka *et al.* 2016, Stefaniak & Lubiatowski *et al.* 2020, Stefaniak & Kubicka *et al.* 2020, Nizinski *et al.* 2024). Up to date research results show that dynamic, interactive visualizations of complex musculoskeletal structures, provided by AR and MR technologies, may facilitate more accurate implant placement (Yanni *et al.* 2021, Tanji *et al.* 2022, Sanchez-Sotelo *et al.* 2024). Additionally, surgeons can remotely contact their colleagues and ask for advice or feedback about the procedure with visible display of holograms (Gregory *et al.* 2018, Verhey *et al.* 2020).

However, despite these promising developments, there remains a need for further investigation into the application of new MR

technologies, as a reliable measurement tool in orthopedic surgery. The main challenge that may reject MR and AR technologies is calibration between the virtual content shown by the headset and the actual surroundings (Longo *et al.* 2024). This may discharge new technologies from their future practical, clinical use.

RSQ HOLO software integrated with Microsoft HoloLens enables the creation of holographic orthopedic equipment components and the measurement tools pre and intraoperatively. This system is portable, sterile and allows for 3D visualization integrated with operation room reality. In this way, the surgeon can safely and freely project a holographic image (created based on a CT scan) onto the operation field during the procedure without having to turn their head. This allows for a comfortable, close-range visualization of the patient's anatomical structures overlaid by needed holographic images (Calem *et al.* 2024).

Aim

In this study, we aimed to determine whether holographic shoulder girdle measurements obtained from Microsoft HoloLens integrated with RSQ HOLO software could be accurately reproduced between different researchers (inter-rater reliability) and consistent with each one's data collected over certain interval of time (intra-rater reliability). Thus checking, if this software has a reliable measurement tool, that could be used efficiently in pre and intraoperative orthopedic surgery settings.

Materials and methods

Forty-two right human scapulas were obtained from the Department of Zoology, Poznań University of Life Sciences. At first, CT scans of collected scapulas were done. Based on these, 3D model reproductions (STL files) were generated using 3D Slicer software (Fedorov *et al.* 2012). Generated files were imported to the cloud that could be accessed using Microsoft HoloLens with RSQ HOLO software. Consequently, measurements were

done using the Ruler tool on RSQ HOLO software (RSQ Technologies, Poznań, Poland) integrated with Microsoft HoloLens headset (Calem *et al.* 2024). Minimal interval of measurement was 0.1 cm. The distances assessed in this study were: **Glenoid height (GH)**: the distance between the highest and lowest points of the glenoid cavity; **Glenoid width (GW)**: the distance between the most anterior and posterior points of the glenoid cavity; **Transverse scapular length/ Scapular width (SW)**: The distance between the medial margin of scapula and the inferior margin of the glenoid cavity.

3 researchers performed measurements two times in an interval of minimum 7 days. Researchers did not have access to each other's results throughout the whole measuring process, so as not to be able to get influenced by them.

Statistical analysis of intra and inter-rater reliability was defined by Intraclass Correlation Coefficient (ICC) in absolute agreement mode. Additionally descriptive statistics as Mean, 95%CI and SD were used to compare groups of measurements. ICC was further defined as poor (<0.5), moderate (0.5–0.75), good (0.75–0.9) or excellent (>0.9) (Koo TK and Li M 2016).

Results

GH measurement intra-rater ICC was overall 0.85 (Separately: Rater no.1: 0.89 ; Rater no.2: 0.84 ; Rater no.3: 0.81). GW measurement intra-rater ICC was overall 0.91 (Separately: Rater no.1: 0.93 ; Rater no.2: 0.89 ; Rater no.3: 0.91). SW measurement intra-rater ICC was overall 0.96 (Separately: Rater no.1: 0.98 ; Rater no.2: 0.94 ; Rater no.3: 0.96). Moving to inter-rater reliability, GH measurement ICC was 0.72. For GW, ICC was 0.78. And for SW 0.91.

Descriptive statistics defined by Mean, 95%CI and SD showed no significant differences among intra and inter-rater groups. For intra-rater GH the mean of the first measure was: 3.6 cm (95%CI: 3.5–3.7; SD: 0.4). For the second measure mean was also: 3.6 cm (95%CI: 3.6–3.7; SD: 0.4). For intra-rater GW the

mean of the first measure was: 2.7 cm (95%CI: 2.6–2.7; SD: 0.3). For the second measure the mean was also 2.7 cm (95%CI: 2.6–2.8; SD: 0.3). For intra-rater SW the mean of the first measure was: 10.6 cm (95%CI: 10.5–10.7; SD: 0.7). For the second measure mean was also 10.6 cm (95%CI: 10.4–10.7; SD: 0.6). Moving to inter-rater comparison, mean measurement done by Rater no.1 for GH was 3.6 cm (95%CI: 3.5–3.7; SD: 0.4), by Rater no.2 mean was 3.7 cm (95%CI: 3.5–3.8; SD: 0.4), and by Rater no.3 mean was 3.6 cm (95%CI: 3.5–3.7; SD: 0.3). GW mean measurement done by Rater no.1 was 2.6 cm (95%CI: 2.6–2.7; SD: 0.3), by Rater no.2 mean was 2.7 cm (95%CI: 2.6–2.8; SD: 0.3), and by Rater no.3 mean was 2.7 cm (95%CI: 2.6–2.8; SD: 0.3). SW mean measurement done by Rater no.1 was 10.5 cm (95%CI: 10.3–10.8; SD: 0.7), by Rater no.2 mean also was 10.5 cm (95%CI: 10.3–10.7; SD: 0.6), and by Rater no.3 mean was 10.7 cm (95%CI: 10.5–11; SD: 0.7).

Discussion

RSQ HOLO software measurement tool proved to be reliable for measurement in orthopedic surgery. The best, excellent ICC agreement was achieved in SW measurement both in intra (ICC: 0.96) and inter-reliability comparison (ICC: 0.91). This was the longest measurement conducted in the study, defined directly by distinct bony edges. Likely for this reason, researchers observed the smallest differences in assessing this distance. In contrast, unlike the scapular edges, the edges of the glenoid are not as sharply delineated. The superior edge of the glenoid and the supraglenoid tubercle show great variety of morphology, hence this may be the explanation why GH was the weakest of our measurements (ICC intra-rater: 0.85; inter-rater 0.72). Furthermore, many patients may present glenoid margin diversity such as osteophytes or hypertrophy due to pathological or aging changes which may also lead to differences in inter-rater measurements originating from different interpretations of the glenoid rim (Zhou et al. 2022). Nonetheless, the consistency of GH and GW measurements was from

good to excellent defined by ICC, with the sole exception of the aforementioned GH inter-rater agreement, being moderate. The mean measurement differences and the 95% CI limits differences in the vast majority of compared groups were below 1 mm. This value is smaller than the measurement error and the measurement interval of the RSQ HOLO program. Only for SW in the inter-rater group, the mean differences and 95% CI limits differences were greater than this value, yet still under 2 mm. This can be explained by the simple fact that this measurement represented the largest dimension in our study (generally > 100 mm). Therefore the 2 mm difference is not clinically significant in this case.

So far, there have only been a few papers confirming the effectiveness of MR in shoulder girdle surgeries. These studies substantiate that technologies, congruent with RSQ HOLO could have clinical benefits. A study by Gregory et al. was first to describe a patient who underwent a reverse total shoulder arthroplasty (rTSA) using AR guidance and perioperative planning. Authors reported that the aid of AR headset enabled better visualization of a patient's anatomy thus making the procedure safer and more efficient (Gregory et al. 2018). Other studies proved better glenoid component placement with MR support (Verborgt et al. 2011, Nashikkar PS et al. 2019, Moreschini et al. 2020). This is crucial because scapular notching associated with glenoid component malposition has been revealed to be one of the most relevant sources of complications after rTSA (Zumstein et al. 2019). Sanchez-Sotelo et al. proved that MR based navigation can be considered as a good alternative to traditional navigation and shows satisfying reliability and accuracy in terms of total shoulder arthroplasty. Authors of the paper mention some advantages of the MR utilization, which include efficient glenoid component placement, cost and time efficiency, universal applications and space effectiveness compared to alternative planning methods. They state, however, that the

learning curve and initial cost of MR devices may be their disadvantages (Sanchez-Sotelo et al. 2024). Moving to scapula fractures Guo et al. evidenced that through pre-operative virtual simulation and intra-operative navigation patients can benefit from shorter operation time and less blood loss (Guo et al. 2022). Moving to elbow joint, another study, to our knowledge first comparing conventional methods of Total Elbow Arthroplasty with AR-based techniques, have demonstrated significant improvements in both translation and rotation accuracy especially for the placement of humeral components (Tanji et al. 2022). Despite aforementioned sufficient support of MR and AR, there is a lack of big number studies conducted in surgery settings. Some current technologies can have difficulty with the superimposition of the scene to the physical world (reality). This may be their main limitation (Berhouet et al. 2019, Longo et al. 2024). These facts prompt us to fully investigate the utility of RSQ HOLO, as we plan to conduct further studies in clinical settings, in procedures like TSA or rTSA. Moreover we intend to compare RSQ HOLO measurements with physical and CT measurements.

This study had potential limitations. First of them is the fact that we conducted measurements in pre-operative conditions. Therefore we were not negatively influenced by limited visibility, as it could be in the operating field. Another aspect is that some of the obtained scapulas were eroded through a natural degradation process of bone tissue, hindering the measurement process.

Conclusion

This study shows that bone morphology can be reliably assessed and measured using mixed reality tools. Overall, MR technologies compared to traditional visualization and measurement methods have plenty of practical advantages and they continue to improve.

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REVIEW ARTICLE

ADVOCACY IN SHOULDER SURGERY: THE AMERICAN PERSPECTIVE

ORĘDOWNICTWO W CHIRURGII BARKU: PERSPEKTYWA AMERYKAŃSKA

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ABSTRACT

Advocacy in medicine is the process of promoting the best interests of patients, providers, and the health care community to the governmental, financial, institutional, and regulatory entities which control or otherwise influence the delivery of health care. Advocacy activities involve participation in professional societies, engagement in the political process, development and promotion of health policy, and formation of relationships with lawmakers, administrators, and regulators. Multiple levels of advocacy exist – from local and state efforts to national and international endeavors. Advocacy can seem intimidating and foreign, especially to medical professionals who have spent their careers developing expertise in entirely different domains, with discrete skill sets distinct from those typically associated with policymaking. With appropriate education, training, experience, resources, and teammates, however, health care providers can prove very effective at advocacy. In our complex and rapidly changing world, shoulder surgeons and related professionals must understand and engage in advocacy in order to fulfill the deepest responsibilities of their sacred commitment to always work for the good of their patients. This manuscript seeks to review the concept and practice of advocacy within the American system, with the hope of sharing our knowledge and experience with our Polish friends and colleagues.

Keywords: advocacy, shoulder and elbow surgery, american perspective, political advocacy, AAOS OrthoPAC, relationships

STRESZCZENIE

Orędownictwo w medycynie to proces promowania najlepszego interesu pacjentów, pracowników służby zdrowia oraz całej społeczności medycznej wobec instytucji rządowych, finansowych, administracyjnych i regulacyjnych, które kontrolują lub wpływają na funkcjonowanie systemu opieki zdrowotnej. Działania w zakresie orędownictwa obejmują uczestnictwo w stowarzyszeniach zawodowych, zaangażowanie w proces polityczny, opracowywanie i promowanie polityki zdrowotnej oraz budowanie relacji z ustawodawcami, administratorami i organami regulacyjnymi. Istnieją różne poziomy adwokatury – od działań lokalnych i stanowych po inicjatywy krajowe i międzynarodowe. Może się ona wydawać skomplikowana i odległa, zwłaszcza dla profesjonalistów medycznych, którzy przez całą swoją karierę rozwijali umiejętności w zupełnie innych obszarach, odmiennych od tych związanych z kształtowaniem polityki zdrowotnej. Jednak przy odpowiedniej edukacji, szkoleniu, doświadczeniu, zasobach i wsparciu zespołu, pracownicy ochrony zdrowia mogą skutecznie angażować się w działania

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Authors reported no source of funding
Authors declared no conflict of interest

Date received: 12th February 2025
Date accepted: 21st February 2025

adwokacyjne. W naszym złożonym i dynamicznie zmieniającym się świecie chirurdzy barku oraz inni specjaliści związani z tą dziedziną muszą rozumieć i uczestniczyć w adwokaturze, aby w pełni realizować swoje fundamentalne zobowiązanie – zawsze działać na rzecz dobra pacjentów. Niniejszy artykuł ma na celu przedstawienie koncepcji i praktyki adwokatury w amerykańskim systemie opieki zdrowotnej, z nadzieją na podzielenie się naszą wiedzą i doświadczeniem z polskimi przyjaciółmi i współpracownikami.

Słowa kluczowe: orędownictwo, chirurgia barku i łokcia, amerykańska perspektywa, adwokatura polityczna, AAOS OrthoPAC, relacje

Introduction

As medical professionals, we have all spent many years studying science. We probably started as children, loving our grade-school classes in biology and the natural sciences, then finding even more joy and fascination as we progressed into chemistry and physics in our university courses. In professional school, we learned to love anatomy, physiology, embryology, pathology, pharmacology, and the other foundational intellectual “tools of our trade.” Some of us spent even more years digging deep into the intricacies of the musculoskeletal system, with a particular focus on our favorite joints – the shoulder and the elbow. All along this road, however, the term “advocacy” was likely absent from our academic pursuits. If it did appear, the word probably showed up during a Clinical Medicine course as we learned to be an “advocate” in the clinical sense for our patients and their families – using our hard-earned scientific knowledge to choose the best treatment plan in every situation.

We probably never learned, or even considered, that we would need to engage in “advocacy” for our patients and ourselves outside of medicine. Many of us, in fact, probably actively avoided entanglement in the political, governmental, and regulatory domains. The personal and intellectual skill set that makes us good at science sometimes runs antithetical to making us good at areas of study and civic life that find their roots in the “soft subjects” of history, economics, law, human resources, business negotiations, and the like. Indeed, many of our mentors and predecessors often

discouraged medical professionals from engaging in advocacy activities – claiming and preaching that “medicine is holy and should not be tarnished by engaging in such base activity as politics,” (Source: unknown but could easily be attributed to several of my early-career teachers). Unfortunately, however, the realities of modern medical practice demand that we understand and engage in advocacy on behalf of our profession, our colleagues, and our patients.

Defining “Advocacy”

My friend and mentor Dr. Richard Hawkins frequently challenged his students to remember the words of Voltaire – “*If we are to converse, then first we must define our terms.*” The term “advocacy” can prove difficult to define. *Oxford Languages* defines advocacy as “public support for or recommendation of a particular cause or policy” (Williams, 2025). The Alliance for Justice defines advocacy as “any action that speaks in favor of, recommends, argues for a cause, supports or defends, or pleads on behalf of others.” (Williams, 2025). Hafiz Kassam, an American expert in advocacy affairs, defines it as “a multifaceted endeavor championing the interests of patients, health care providers, and the broader community within the health care system. It encompasses efforts to raise awareness about health care issues, influence policy decisions, and promote initiatives to enhance health care delivery and outcomes. At its core, health care advocacy seeks to ensure fair access to high-quality, affordable health care services while aligning

policies with the best interests of patients and providers.” (Davis, 2021, Kassam, 2025). Indeed, advocacy involves a departure from our “comfort zone” of the actual practice of medicine and performance of surgery into the complex world of policy, government, and finance that underlies and informs our ability to deliver care.

Levels of advocacy

Dr. Kay Kirkpatrick, a retired hand surgeon and now a multi-term State Senator in Georgia, declares simply that advocacy is critical to surgeons at both “the state and federal level because of the many issues that are affected by the government” (Kirkpatrick & Gurman, 2020). Although commonalities exist between state and federal government systems, each level is unique and will impact the provision of care in different ways. Both levels require involvement and attention, but often also demand slightly different skill sets for those seeking to advocate (Lefever *et al.*, 2021).

In the United States, laws and regulations governing health care can vary significantly between different states. Consider the political “hot button” of abortion, a “medical” issue which has pitted liberal and conservative forces against each other for decades. The battle seems almost like a civil war in our nation, as different states have dramatically different laws governing the availability of abortion pills and procedures. In recent years, transgender surgery and hormone therapy have taken a similar path of variance in access along state lines – further distinguishing the culture in “red states” and “blue states.” In addition to the availability of certain medical procedures, state laws also govern issues such as medical licensing and scope of practice, medical malpractice (tort law), malpractice insurance coverage, Medicaid programs, and some facets of the health insurance industry. State laws also can require a “Certificate of Need” (CON) for opening new health care facilities or upgrading existing ones – an issue that dramatically influences a surgeon’s ability to operate in a surgery center versus

a hospital. As such, advocacy at the state level can prove vital – as state governments can often move more quickly and decisively than the federal government. Relationships, the key to advocacy, often prove easier to form at the state level due to the smaller size and geographic scope.

The federal government, meanwhile, also influences the practice of medicine through both legislation and regulation. Federal law governs, among other things, physician-owned hospitals, some aspects of the private health-insurance industry (such as Medicare Advantage), and policies regarding access to drugs and medications (Moor, 2025). Most importantly, the federal government holds the purse strings for funding a huge percentage of the annual expenditures on health care, paid out through Medicare and Social Security (federal programs), and indirectly through Medicaid (a state-level program) and private insurance companies – both of which often base their policies and payment rates on those of Medicare. The Centers for Medicare and Medicaid Services (CMS) is a federal regulatory agency that determines the intricate rules of healthcare under the federal system, influencing care in all states and territories. Although it is overseen and funded by Congress, it ultimately functions with some level of independence – requiring surgeons to understand regulatory advocacy in addition to political advocacy. National-level advocacy therefore differs greatly from state-level advocacy in that the system is larger, slower, and more resistant to the formation of meaningful individual relationships due to its size, scope, and geographic challenges.

While advocacy in America mostly focuses on issues at the state or national level, it can also extend down to the local level and up to the international level. Local medical advocacy issues can include programs for health-care outreach, free clinics, blood drives, sports physicals, or other public health measures. International medical advocacy issues can include access to orthopedic implants, cross-cultural training and education, and disaster

relief. Advocacy at these levels, however, tends to take a different approach than the more familiar (and similar) approaches to advocacy at the state and national levels.

Methods of advocacy

A large spectrum of “advocacy activities” exists, and it ranges from simple to complex. As single constituents, we can write emails or letters to our elected representatives about important issues – but these communiques often end up on the desk of just a low-level staffer or even in the trash bin. We can meet with insurance executives to discuss coverage and reimbursement – and they likely will just look on patronizingly, nod, smile, and ignore us. In today’s vast system, the individual voice often finds itself woefully soft and unheard unless it is somehow tied to an effective means of entry.

The most common means of entry to the advocacy process lies in the power of numbers. Through collaboration as a profession, our *collective voice* can reach a volume loud enough to make a difference. As such, our various American orthopedic and specialty professional associations form the backbone of effective advocacy. At a minimum, all providers should support their professional societies’ advocacy efforts through membership in the society and financial contributions to advocacy. Not every medical professional will have the ability or interest to engage directly in advocacy work, but there is no excuse not to support those who do – specifically through financial means. Some individuals may choose to participate more deeply and actively in these organizations through committee work and leadership, but their efforts will be limited without meaningful financial backing from the members of the organization. In advocacy, leaders ultimately will prove only as powerful as the commitment of the membership they represent.

Ultimately, the most effective means of entry into advocacy lies in *relationships* (Bushnell, 2017, Port & Joyce, 2025). A myriad of relationships across an interpersonal network

characterizes many successful advocates. Surgeons can communicate with colleagues, professional association staffers, friends in other industries, society leaders, and others to coordinate advocacy efforts (Goltz *et al.*, 2025). While much less common and much harder to achieve, however, personal relationships with “difference-makers” such as high-ranking administrators, regulators, and even actual lawmakers have no equal in terms of efficacy (Port & Joyce, 2025). That same constituent’s individual text, phone call, or email to a lawmaker mentioned above will take on significantly more gravitas if the sender has a personal relationship with the recipient. Leaders of professional societies can much more effectively advance their agenda if they have a relationship with powerful individuals that can influence policy in their favor. Policymakers may even seek out physicians with whom they have a relationship to ask for advice on various issues or votes related to health care (Port & Joyce, 2025). In short, relationships are *advocacy gold*.

Relationships in advocacy, however, take time and intentional planning to identify and build – like playing chess instead of checkers. Good relationships cannot be rushed – they take a long time to build and nurture (Kirkpatrick & Gurman, 2020). As such, relationship and network building can never begin too early in one’s medical career! Likewise, participating in or contributing to the campaigns for political leaders early in *their* careers can pay dividends when they reach greater heights later. For example, the local candidate for the school board may ultimately run for Governor or Senator, and likely she will remember and retain relationships with her supporters from the early days more so than the latecomers who appeared only after she had attained some notoriety.

Access to policymakers often requires financial contributions and commitments, which must be rationed and targeted effectively. Access for relationship-building can also be obtained through professional societies, lobbyists, and political organizations.

In the United States, many groups will travel to Washington, DC, and to state capitals to interact with lawmakers (Kassam, 2025, Kirkpatrick & Gurman, 2020, Lefever *et al.*, 2021, Williams, 2025). Surgeons can participate in these efforts as first-timers getting to know their representatives, and also eventually as “old friends” coming to visit with their elected officials (Sethi *et al.*, 2013). On the other hand, physicians can invite policymakers to join them in their place of practice (or even to come and shadow them through a day in surgery!) to expose them to the proverbial trenches of health care delivery (Goltz *et al.*, 2025, Kassam, 2025).

Health care advocates must often put their own personal political leanings aside and work with candidates or representatives with differing political views on non-medical issues. Indeed, bipartisan success at any level usually hinges upon personal relationships that cross ideological lines. While engaging in advocacy on behalf of their patients or their profession, surgeons must always remember to keep the advocacy agenda as a professional one rather than a personal one. For example, a conservative surgeon may oppose a liberal representative’s stance on taxes or disagree with them about social issues – but they must be willing to work with that lawmaker if they share common goals regarding health care policies. In short, the relationship is personal but the agenda cannot be.

Advocacy resources

Founded in 1999, the Political Action Committee of the American Association of Orthopedic Surgeons (AAOS OrthoPAC) claims the throne as the best-funded and most effective national body for musculoskeletal advocacy in the United States. In fact, it often ranks as one of the best-funded and most-active of any medical-related political action committee. Many American orthopedic specialty societies, including the American Shoulder and Elbow Surgeons (ASES), have their own Advocacy or Health Policy committees and task forces. The specialty societies engage

with the OrthoPAC for collaborative advocacy efforts and seek to present a “unified front” on most national-level issues. At times, however, specialty societies will promote specific agendas unique to their missions, with targeted activities funded in addition to those of the OrthoPAC (Kassam, 2025, Williams, 2025). ASES, for example, hosts a “fly-in” event every year in which the Frankle Health Policy Fellows will visit Washington, DC, for a few days to meet with various policymakers and discuss issues unique to shoulder surgery in addition to “big picture” policies impacting health care as a whole (Goltz *et al.*, 2025, Layuno-Matos *et al.*, 2025).

At the state level, state medical, state orthopedic, and state subspecialty societies present the prime choice for advocacy resources. The level of sophistication (and therefore success) of these organizations varies by state, and usually relates directly to the level of membership involvement and financial commitment. The national OrthoPAC also has resources that assist state societies – especially on issues that straddle both levels of government, such as insurance prior authorization requirements (Banks *et al.*, 2025, Jarrett *et al.*, 2024). Orthopedic groups, hospitals, and health systems also can have resources of their own brought to bear at the state level, where they can still often prove effective due to the relatively smaller size of the state government.

Lobbyists – professionals who spend their careers focused on government relations and seek to influence policy in favor of their clients – form an indispensable resource to any advocacy efforts. At both the state and national level, lobbyists can specialize in various industries or topic areas (such as health care), and the longevity of their career usually far exceeds that of many lawmakers (Bushnell, 2017). In other words, elected representatives may come and go, but lobbyists stick around. As such, interaction between lobbyists and professional societies is critical. Many professional societies at both the state and national levels will contract with an independent lobbying firm or even employ lobbyists directly.

At the federal level, professional lobbyists usually live in or near Washington, DC, and form a critical local access point for surgeons who may live thousands of miles away. Similar geographic models exist at the state level.

Advocacy allies

Dr. Aaron Chamberlain reminds us that “when engaging in advocacy, it is key to understand the advocacy interests of the various stakeholders and how they align or don’t align on certain issues” (Chamberlain, 2025). In pursuing advocacy goals, we must always seek out allies – even in unexpected places. Even though our orthopedic professional societies usually set their own agendas and make their own efforts, certain issues may lend themselves to alignment with other professional societies, hospitals, health systems, and even insurance companies that seek similar policy changes or improvements from the government or its regulatory bodies. Allies can also exist outside of medicine altogether – exemplified by recent state-level efforts in Georgia that have seen orthopedic surgeons team up with restaurant owners and long-haul truckers to work together for reform of the tort laws that govern the otherwise seemingly unrelated fields of medical malpractice, premises negligence, and highway liability. Even the government itself may prove to be an advocacy ally, as lawmakers may directly solicit the expertise of surgeons and other health care professionals when developing policies.

Advocacy strategies

Through our various channels for advocacy, thought leaders develop strategies for both offense and defense in the realm of policy – just as a coach would design a game plan in the realm of sports. “Offense” in advocacy involves the active creation and promotion of policy and initiatives that favor patients, providers, and the health systems in which they operate. On the other hand, “defense” in advocacy involves monitoring and preventing policies, regulations, and actions that will not

benefit, or may even actively harm, patients, providers, and health systems.

One example of “offense” in advocacy on display was a 2017 law passed in my home state of Georgia that protected out-of-state sports medicine physicians covering visiting teams (Bushnell, 2017). After recognizing that our colleagues were exposed to medicolegal risk by technically practicing without an in-state license, we designed a bill to solve this problem and then worked tirelessly to see it implemented into reality (Bushnell, 2017). Other examples include the creation and/or promotion of laws and policies that increase resources for at-risk patient populations, support and protect hardworking providers, or fund medical education. Examples of “defense” in advocacy involve working against reimbursement cuts for providers, fighting scope-of-practice extensions for less-qualified professionals, and speaking truth about the medical effects of legalizing harmful things like marijuana or online gambling (Abboud *et al.*, 2019, Cronin *et al.*, 2025, Kassam, 2025, Moor, 2024, Port & Joyce, 2025, Sethi *et al.*, 2013). Unfortunately, we usually find ourselves playing defense much more frequently than offense. Some advocacy projects involve a combination both “offense” and “defense” – such as exposing and seeking to improve, replace, or prohibit practices that block patient’s access to care, such as baseless requirements for pre-operative physical therapy or resource-wasting prior-authorization review requirements from insurance companies (Banks *et al.*, 2025, Jarrett *et al.*, 2024).

Advocacy funding

Advocacy efforts cost money. Travel costs, publication and communication costs, political fundraising and contributions – it all adds up quickly. Physicians, unfortunately, have historically ranked at the bottom of the list in terms of their willingness to provide financial support for advocacy, relative to other professions. Lawyers, insurance companies, hospitals, and other historical antagonists to shoulder surgeons in the realm of policy,

however, usually support their own professions' advocacy efforts *much* more robustly. For example, the AAOS OrthoPAC for years has ranked as one of the best-supported health care political action committees in the country, with approximately 25–30% of orthopedic surgeons donating to the organization. The American Association for Justice (AAJ – formerly known as the American Trial Lawyers Association/ATLA), on the other hand, routinely boasts participation rates above 97%! Surgeons thus still have a long way to go when it comes to advocacy funding. In a proud bright spot, however, the ASES has led the way amongst the various national orthopedic specialty societies in terms of donation levels – winning three consecutive OrthoPAC “Hall of Fame” awards since 2022.

Future directions

As clinician-scientists, we have always understood the interplay between patient care and scientific advancement. Over a decade ago, however, Dr. Manny Sethi (who actually ran for a U.S. Senate seat in Tennessee in 2020) proposed that we re-define the continuum of care “to a trinity of clinical excellence, innovative research, and effective advocacy” (Sethi *et al.*, 2013). Using Sethi's trinity model, we hope that all medical professionals will shift their views on advocacy from its position as a “third rail” (i.e., an issue too controversial to mention) to a “third column” critical to our professional success. Today's leaders within American orthopedic surgery have embraced this recommendation and continue to work tirelessly to integrate advocacy training and advocacy efforts into the curricula of postgraduate internship and residency, as well as into the lifeblood of our state and national professional organizations and specialty societies (Daniels *et al.*, 2013, Goltz *et al.*, 2025). We have analyzed the advocacy efforts of our societies and sought to tailor programming towards it (Abboud *et al.*, 2019, Cronin *et al.*, 2025). We have funded advocacy fellowships, through which we look forward to a new generation of advocates

creating innovative ways to accomplish our goals (Layuno-Matos *et al.*, 2025). We have intentionally made focused, specific inclusion of advocacy research and discussions in our professional literature (Bushnell, 2025). We have discussed advocacy and advocacy research at our educational meetings and events (Kassam, 2025, Layuno-Matos *et al.*, 2025, Williams, 2025). As our profession grows ever-more intertwined across the globe, we hope to share these advocacy adventures and lessons with our colleagues abroad, as well as to learn from their experiences as well (Aurich *et al.*, 2025, de Marinis *et al.*, 2025, Lech *et al.*, 2025, Lubiowski *et al.*, 2025, Sandow & Gill, 2025, Sugaya, 2025).

Lessons for Poland

I cannot claim to understand Poland's history and system of government well enough to offer advice of any considerable intricacy or specificity regarding advocacy. As a relatively young Western democracy, Poland in its present form lacks the longstanding history and traditions of American government. But it also can learn from the many mistakes we Americans have made along the way. Likewise, Polish health care professionals can also benefit from the experience we in America have gained along our advocacy journey. I would propose that successful advocacy within our field of shoulder and elbow surgery ultimately finds five critical pillars at its foundation: 1) commitment by a critical mass of surgeons to a professional society acting in the collective interest of its members; 2) dedicated and continuous financial support of advocacy efforts of these professional societies by all stakeholders; 3) leadership in advocacy by surgeons with interest and skill sets appropriate to the task; 4) effective partnership with government relations professionals and other allies; and 5) perhaps most importantly, meaningful personal relationships with policymakers.

In America, we orthopedic surgeons still have much to learn about advocacy. You do here in Poland as well. I am so thankful for

the opportunity to be a guest of your Polish Shoulder and Elbow Society this year to discuss this critical and fascinating topic. In doing so, I hope that we can help each other refine the *what*, the *when*, and the *how* of advocacy to reach maximum effectiveness. We will appreciate our commonalities, but we will certainly see differences as well. Most importantly, we can definitely agree upon the *why* of advocacy contained in the words of our shared Hippocratic Oath – “I will remember that I do not treat a fever chart, a cancerous growth, a data point, or an algorithm’s suggestion, but a human being” (Mesko & Spiegel, 2022).

Acknowledgements

Dr. Bushnell reports the following Conflicts of Interest:

None of which are related to the content of this manuscript.

Consulting fees, research support, and speaker fees from Smith + Nephew, Inc.

Consulting fees from Ossio, Inc.

Board/Committee Positions in American Shoulder and Elbow Surgeons (ASES), Georgia Orthopedic Society, Georgia Shoulder and Elbow Society.

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REVIEW ARTICLE

MY PATH AS AN ORTHOPEDIC SURGEON: TIPS AND TRICKS FOR JUNIOR DOCTORS

MOJA DROGA JAKO CHIRURGA ORTOPEDY: WSKAZÓWKI I TRIKI DLA MŁODYCH LEKARZY

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ABSTRACT

Although medical school and orthopedic residency prepare orthopedic surgeons for the technical and scientific aspects of their careers, training programs often under-emphasize topics such as health policy, advocacy, business, finance, practice management, and professionalism. These areas, however, often determine a physician's success just as much as the ability to diagnose and treat pathology of the musculoskeletal system. Formal training can also focus too much on the surgeon as a professional and not enough as a person – underestimating the importance of individual's family, friends, personal finances, and mental, physical, and spiritual health on their ability to perform their job at the highest level. Whether practicing in Poland, the United States, or elsewhere in the world, many commonalities for success exist for junior surgeons as they begin their careers, and these pearls can be taught and shared just like the finer points of surgical technique or radiographic interpretation. This article attempts to provide some advice for early-career doctors that can help to launch them towards personal and professional fulfillment, based upon things I have learned along my own path as an orthopedic surgeon.

Keywords: practice management, advocacy, tips and tricks, business basics, junior doctors, the journey, things I wish I had known

STRESZCZENIE

Chociaż studia medyczne i rezydentura z ortopedii przygotowują chirurgów ortopedów do technicznych i naukowych aspektów ich kariery, programy szkoleniowe często nie kładą wystarczającego nacisku na takie zagadnienia jak polityka zdrowotna, adwokatura, zarządzanie biznesem, finanse, prowadzenie praktyki oraz profesjonalizm. Tymczasem to właśnie te aspekty mogą w równym stopniu decydować o sukcesie lekarza, co umiejętność diagnozowania i leczenia schorzeń układu mięśniowo-szkieletowego. Formalne kształcenie koncentruje się również zbyt mocno na roli chirurga jako profesjonalisty, a za mało na nim jako człowieku – niedoceniając wpływu rodziny, przyjaciół, sytuacji finansowej oraz zdrowia psychicznego, fizycznego i duchowego na zdolność do wykonywania pracy na najwyższym poziomie. Niezależnie od tego, czy chirurg rozpoczyna praktykę w Polsce, Stanach Zjednoczonych, czy gdziekolwiek indziej na świecie, istnieją uniwersalne wskazówki, które mogą pomóc młodym lekarzom w pierwszych latach kariery, tak jak uczy się ich zaawansowanych technik

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Authors reported no source of funding
Authors declared no conflict of interest

Date received: 17th February 2025
Date accepted: 27th February 2025

chirurgicznych czy interpretacji radiologicznych. Niniejszy artykuł przedstawia praktyczne porady dla początkujących chirurgów, które – na podstawie mojego własnego doświadczenia jako chirurga ortopedy – mogą pomóc im osiągnąć zarówno zawodowe, jak i osobiste spełnienie.

Słowa kluczowe: zarządzanie praktyką, orędownictwo, wskazówki i triki, podstawy biznesu, młodzi lekarze, droga zawodowa, rzeczy, które chciałbym wiedzieć na początku

Introduction

Orthopedic surgeons spend many years in training as they learn their craft and hone their skills. University, medical school, residency, fellowship, and additional specialty education can take a decade or more to complete. After this extensive time in training, surgeons often find themselves feeling lost, intimidated, confused, and frustrated as they begin their careers in the “real world” as a practicing physician. When clinical and surgical challenges arise, young doctors at least feel somewhat prepared to meet them – given that medicine has been the main focus of their lives for a long time. When challenges arise in other areas, however, neophytes can realize that their training simply did not prepare them to answer some of the questions that *really* matter. How does a private practice surgeon run their business? How do the most famous physicians build their name brand? How does a doctor build and protect personal financial security? How do great orthopedists still make great spouses, moms, and dads? Finding answers to these types of questions quickly becomes the new focus of most doctors after they finish their formal career preparation.

I decided that I wanted to be a physician when I was about seven years old. I grew up in Athens, Georgia, watching my grandfather serve our community for 53 years as an internal medicine physician. He was my hero, and his love for his patients and his profession provided an inspiring model for me. I graduated from Vanderbilt University with a degree in Religious Studies and then attended medical school at the Medical College of Georgia. I completed a general surgery internship and an orthopedic surgery residency at

the University of North Carolina, followed by a sports medicine fellowship in Denver, Colorado at the Steadman-Hawkins Clinic Denver. In 2009, I joined the Harbin Clinic in Rome, Georgia – the largest multi-specialty private clinic in the state. Since that time, my practice has focused mostly on knee and shoulder surgery, with a particular interest in shoulder research, advocacy promotion, and professional leadership at the state and national levels. Once in practice, I earned a Master’s degree in Business Administration from Auburn University and have lectured extensively about career development for medical professionals. Ten years ago, I even published a small book about business basics for junior doctors (Larson *et al.*, 2012).

My friend Przemko Lubiowski asked me to share some of the lessons along my path in orthopedics at the 2025 Meeting of the Polish Shoulder and Elbow Society, and to put together a brief paper about the same topic. In doing so, I’ve enlisted the help of my trusted cadre of physician assistants – wonderful people and consummate professionals who make up the core of my “work family.” I hope that this paper can provide some tips and tricks to younger doctors as they begin their careers, and maybe even some of our seasoned colleagues can also find a few pearls herein.

Health policy and advocacy

No surgeon practices in a vacuum. Whether in Poland, America, or elsewhere, the practice of orthopedic surgery occurs within a complicated environment. The practice ecosystem is developed and influenced at the local, regional, and national levels, and it determines what a surgeon can do, where they can do it, how

they can do it, and how they are paid for it. While in training, physicians tend to “put their head down and work through it” when it comes to interaction with the intricate web of rules and regulations governing their professional existence. Indeed, they are often just too busy learning orthopedics and caring for patients to do much else! In practice, however, understanding the systems in which you operate and the policies that inform those systems becomes absolutely critical. Surgeons actually *can* influence the policies that impact their professional environment, but they must *understand* policy first. After you understand health policy, you can advocate for change and optimization of it.

Advocacy is the complex process of pursuing the best interests of patients and physicians as it relates to the governmental, regulatory, and financial institutions that impact the delivery of care (Kassam, 2025, Lubiatowski et al., 2025, Williams, 2025). Like many physicians, I became interested in advocacy and health policy only *after* I had finished training and started a “real job” – mostly because I began to realize how they impacted me and my patients on a daily basis in that job. I first became exposed to organized orthopedic advocacy at the state level through involvement with and leadership in the Georgia Orthopedic Society (GOS) – a state-level group that remains deeply connected with our state-level government. I also participated in advocacy efforts at the national and international levels through leadership positions in the Arthroscopy Association of North America (AANA) and the American Shoulder and Elbow Surgeons (ASES). Through these organizations, we have impacted health policy and made things better for our patients and our profession. In fact, I consider our advocacy work to be some of the most meaningful contributions of my career, and I strongly encourage early-career surgeons to seek out their own opportunities to participate in advocacy and health policy development. Regardless of where you live and practice, you the surgeon are best suited to advocate on the issues you know best.

Practice management – business and finance

The business and financial aspects of starting or joining an orthopedic practice can prove just as complicated as the most challenging surgery. Consider, for example, an infected total elbow replacement or a revision arthroscopic Latarjet. You learned how to handle these surgical conundrums through devoted study and then by starting out first with the successful performance of more straightforward surgical procedures. You could not yet handle such tough surgical situations as a medical student, but the point is that you *started* the process of learning to handle them. The same approach holds true for learning about business and finance. Just because these topics may seem foreign to you, your discomfort with them does not abdicate you from your responsibility to begin to understand them – especially as they relate to your ability to provide care for your patients.

In the United States, a surgeon’s practice model (e.g., private practice versus hospital-employed) directly influences their motivation to become involved with the financial aspects of a practice. Obviously anyone working as a business owner will seek to understand their business well, and an aspiring partner in an orthopedic practice should behave no differently. Even an employed physician in a large hospital system, however, also has a responsibility to their employer, their colleagues, and their patients to understand departmental finances and business practices. Optimization of these aspects of a practice will result in more efficient care and improved organizational health – both of which usually translate to job security and potentially increased pay (Rahman et al., 2024). In Poland, the same concepts apply. Regardless of your practice model, learn about business and finance. Understand the revenue cycle (Ouillette et al., 2024). Investigate business courses online, through one of many professional societies, or even through formal university-based training programs. Advanced training or a degree in business can pay significant dividends if you seek to assume a leadership

position – whether it might be as an institutional department chair or as the managing partner of a private group. But even those at the highest levels of education in business must begin with the desire to start learning.

Practice management – teamwork and culture

Orthopedic surgeons have the honor, privilege, and responsibility of leading teams in the provision of care. In understanding their role as a *servant* leader, doctors can create a culture of excellence for their team (Andrews, 2019). The attitude of team-building applies whether your team consists only of the nurses, technicians, and assistants in your clinic or operating room, or a large group of medical students, residents, fellows, and even other surgeons. Culture permeates and informs behavior at all levels. During my time in private practice, I've tried to build a culture wherein my teams can easily quote a few pithy sayings that we use to govern our approach to care.

“Availability, Affability, Ability.” – In order, these traits lead to success as a surgeon and as a team. Patients want a surgeon who is *able*, but a certain level of skill and expertise are usually assumed by patients. As such, patients tend to choose a physician that they *like* (or whom they have heard their friends like) above one who is perhaps not as *affable*. Finally, especially in the modern American “Amazon Prime” culture of rapid access, patients tend to hate waiting – even if they wait slightly longer for the best surgeon in the world. They will often choose the first *available* option over the “best” option (Andrews, 2019). As such, seek to be all three – available, affable, and able – but remember the order.

“Take your job seriously, but not yourselves.” – As surgeons, we should always strive to maintain our humility and remember that the privilege of providing care to patients is *ours*, not the other way around (Hawkins, 2019, Mallon, 2018). Our teams function better in a relaxed atmosphere where the sanctity of our professional calling remains paramount – not the ego of the surgeon.

Remember to smile and to laugh! You will encounter enough sadness and hardships along the way, and sometimes you will have to deliver tough diagnoses or results. So don't forget to celebrate the good days and the successful patient outcomes.

“Take a second.” – At times, taking an extra second in a world as busy and demanding as ours may seem impossible. However, when you step back and consider the bigger picture, you'll realize that 300 seconds add up to just five minutes of your day. Some seconds are expendable; when applied deliberately, however, they can accumulate into something meaningful. Take an extra second with a patient and spend a moment longer with them or their family. Step back and take a second *look* at the problem in front of you – you may notice something critical or different about it. Likewise, understand your limitations enough to take a ‘second fiddle’ role: knowing when to bridge the end of your knowledge to someone else's expertise. Take an extra second in the hallway to commend the work done by hospital staff who might otherwise go unrecognized. Lastly, take a second for yourself. Medicine demands our time, but no one has ever regretted taking an extra moment to reset, refocus, and breathe. The small, humble moments – when approached with intention – can have the greatest impact, so take that second.

“Silence is a killer.” – We seek to create and maintain an environment where no member of the team fears to speak up about issues of patient safety. We emphasize that everyone's observations matter equally when it comes to equipment, medications, positioning, orders, etc. Failure to speak up can result in complications or other problems, so all team members feel safe and supported to raise concerns.

“Don't let the sun go down on questions.” – Do your best to answer patient questions and messages about their care with minimal delay. Respect their concerns and try to prevent them from reaching out to other providers who may not give them correct information. Prompt replies can prevent unnecessary

visits to the ER and other wasteful, reactionary responses to patient concerns. Patients may also perceive delay in response as an implication that you simply do not care about them. So end each day with an empty inbox and voicemail.

“Practice medicine in person.” – Even in today’s age of telehealth and digital communication, no substitute exists for direct interpersonal contact. Bring patients into the office for evaluation instead of trying to resolve difficult problems over the phone or via messages. Patients and families may not be able to accurately describe what they are seeing. Also, therapists or a patient’s friends may create anxiety by making comments about their postop appearance. Seeing the patient in person allows you to address their concerns face-to-face and to identify an impending problem that can be caught timely. On the other hand, if their progress is appropriate, then the patient can be directly reassured that there is nothing abnormal and will return home with confidence and appreciation.

“Take care of the troops.” – Your team has multiple members whose level of dedication to patient care and to your professional success can either make or break your practice. Make sure your team knows that you support them and their judgment. Treat them as professionals without micro-managing them. Say “thank you,” and “I appreciate you,” as often as possible. When your team feels recognized and appreciated, they will maintain a high level of commitment to their work and to you.

“To demand team excellence, first you must teach it.” – We have high standards in our practice for all team members – whether they are a new Medical Office Assistant (MOA) or a longstanding Physician Associate (PA). However, these standards must be taught before they become inherent within the team culture. Invest time in training all staff members to make sure they know what they are doing and why they are doing it. Have everyone on the same page with how to take

care of common patient issues and questions so that patients hear a harmonized message from the team.

“Learners make the best teachers, and teachers make the best learners.” – Whether your role as a teacher involves your own employees or an entire medical university, seeking lifelong learning in all areas will make you the best possible teacher (Hawkins, 2019, Sterett, 2024). One of the beauties of orthopedic surgery is its constant pursuit of new clinical and scientific knowledge – meaning that we will always have more to learn. Even early in your career, when you at times may feel clueless, you may find you have ways to share your knowledge with others. Seek these opportunities and invest in them. Also remember that teaching can go both ways when it comes to your employees and subordinates, who often can provide valuable contributions to educating you about things at work. Involve staff feedback to develop clinic flow and efficiency, and meet periodically to talk through potential process improvements. Staff see all the inter-office issues that can create inefficiency and wasted time/effort in getting patients seen. Harnessing their unique insight can help eliminate these problems.

“Always tell the truth.” – Especially in the most stressful situations, always handle patient complaints and complications with honesty and sincerity (Andrews, 2019, Sterett, 2024). Most of the time, poor outcomes and patient grievances are *not* the fault of the surgeon or the team – but poor communication can exacerbate the situation. Our patients realize that we are human and in most cases prove willing to forgive us when we have made a mistake. Open, honest, compassionate, and deliberate communication has the power to defuse tense situations and even to strengthen the bond of trust between patient and physician. Some of my closest patient relationships have been forged in the fires of complications and suboptimal outcomes. When I’ve happened to ask why these patients stayed with me during our tough times together, the answer seems

universal – “because I trust you.” Trust comes from truth: do not deviate from it no matter how painful it may seem.

“Doctors must also be translators.” – The famous theologian C.S. Lewis encouraged his readers to “Translate every bit of your Theology into the vernacular. I have come to the conclusion that if you cannot translate your thoughts into uneducated language, then your thoughts were confused. Power to translate is the test of having really understood one’s own meaning” (McCusker, 2014). The same holds true for us. Translating complex orthopedic concepts and surgical techniques into plain language allows patients and their families to understand their care plan. It also improves the bond of humanity between doctor and patient by meeting them at their own level. Finally, it also helps us to make sure our own thoughts and surgical plan are not confused when we can translate them from jargon into vernacular.

“Make friends.” – Teamwork also applies to being a part of the larger setting of health care delivery in which other physicians and health care professionals play roles complimentary to yours. Remember that your enemies are pain, suffering, and disease – not the “competitor” orthopedic practice down the street or across town who also does shoulder and elbow surgery. Develop a network of colleagues both within and outside of orthopedics. This network will generate plenty of referrals, and it can prove vital for managing difficult cases and handling the clinical and psychological stress of complications (Richard et al., 2024).

Personal finances

When I was a medical student, one of my favorite residents – now a family practitioner – told me, “Don’t keep your medicine and your money in the same pocket.” This aphorism implies that as surgeons, we should never make clinical choices for our personal financial benefit. If you have financial pressures on the personal level, whether from debt, overspending, family demands, or other reasons, you will certainly face temptation to make

decisions that lead to higher reimbursement. I teach my medical students that surgeons in the United States get paid to *operate* and not necessarily to *do the right thing* – and in many situations, surgery is *not* the best answer for the patient. It is infinitely easier to make the *right* clinical decision if your personal finances do not create a source of stress that can cloud your professional judgment.

A detailed discussion of personal finance could fill books and blogs (Dahle, 2025, Dahle, 2014, Larson et al., 2012), but I think that the best advice in this area is “If you want to be rich, don’t *act* rich” (Bushnell, 2015). You can either spend your money, or you can save and invest it. Spending too much money early in your career creates an illusion of wealth, but it does not create *actual* wealth. Make a plan for paying off debt and building long-term wealth through savings and investments. Debt makes the “debtor a slave to the lender” (Proverbs 22:7) and can be a major cause of burnout and mental health issues – so pay it off as fast as you can. Meanwhile, “live like a resident” in your spending habits and refrain from wasting your money on material items such as an expensive house, vehicle, jewelry, clothes, etc. (Bushnell, 2015, Dahle, 2025, Dahle, 2014). Maintaining a modest “resident-level” budget after you begin to earn “attending-level” salary can prove extremely powerful.

Mental and physical health

In the United States, orthopedic surgeons have one of the highest rates of suicide amongst medical professionals, often attributed to high rates of burnout (Pearl et al., 2023, Ross et al., 2025). The stress factors that lead to burnout are common in orthopedists in other Western countries as well (Bischoff et al., 2023, Kollias et al., 2020). Younger surgeons can be particularly prone to burnout, especially in the early years of establishing their practice while still adjusting to the transition from the long hours of their training (Pearl et al., 2023). As health systems, especially in the

United States, become more corporatized and influenced by governmental and health insurance companies, “moral injury” can occur when surgeons know the right thing to do for their patients but are not *allowed* to do it by the system (Gebhardt, 2023). Longstanding exposure to moral injury can lead to burnout and depression. Unfortunately, surgeons’ mental health is a factor that often goes vastly underappreciated, unmeasured, and unsupported in many health systems (Wallace et al., 2009). As such, surgeons must recognize the risk and potential for mental health stress and burnout, and seek out wellness programs and support networks. Meanwhile, our professional societies need to continue to advocate for systemic change that minimizes moral injury to physicians.

I have found that the most challenging times for my mental health have often corresponded with times that I have marginalized my physical health and personal fitness. Even though I have finished two full Ironman Triathlons, there have been times as well when I could not even run a 5K without feeling exhausted. Those out-of-shape times correlated with periods of burnout and frustration on the professional side. Prioritizing physical health absolutely improves professional performance (Pearl et al., 2023, Ross et al., 2025). Forming habits that make exercise part of a daily routine is critical for junior doctors – because it certainly doesn’t get any easier to begin an exercise regimen as you age!

Spiritual health

I grew up as a Christian, and my personal faith in Jesus continues to guide and inform all that I do in my professional and personal life. As a Christian, I believe that all of us are imperfect and make plenty of mistakes – but that God forgives us. As a surgeon, perfection remains our constant standard, even if many times we cannot quite reach it. My faith and its emphasis on the primacy of forgiveness serves as a critical counterbalance to the orthopedic culture of perfection.

My faith has immensely helped me at dark times in my life work through complications, challenges, depression, illness, death, and uncertainty. I cannot imagine walking this path alone in the spiritual realm. Whatever your own faith tradition may be, cling tight to it, nurture it and develop it, and find your rest in it as you go.

Family and friends

Professional responsibilities for the young orthopedic surgeon can rapidly expand and, if poorly managed, can completely dominate one’s time and attention. We do have a critical responsibility to our patients, and all of us took an oath to act in their best interest (Mesko & Spiegel, 2022, Morrey, 2019). That commitment, however, is best fulfilled from the stable foundational platform of a solid family situation. Indeed, many of us also made vows to a spouse, and indirectly to our children. We ignore or minimize those vows to our personal and professional peril (Morrey, 2019). As I learned from many of my own trusted mentors, “Family is number one.” (Andrews, 2019, Hawkins, 2019, Mallon, 2018, Morrey, 2019, Sterett, 2024). Problems at home quickly become problems at work, and serenity at home can lead to more effective professional pursuits. Our family and friends understand that our careers require some sacrifice, but they also know that such sacrifice need not be *complete*. In *Choosing to Cheat*, the famous author Andy Stanley teaches us that striking a balance between work and home requires constant management, and that every decision of where to spend our time in one area of life involves choosing to “cheat” another area (Stanley, 2003). We must never “cheat” too much in one area.

In addition to prioritizing my “home family,” I have also sought to treat my patients, staff, and colleagues as my “work family.” Just as a nuclear family cares for one another even in the midst of challenges and disputes, a work family maintains a culture of mutual respect, concern, and support (Mallon, 2018). While

such culture begins with an attitude, it also encompasses direct planning – from simple celebrations of birthdays with lunch in the office to bigger endeavors, such as social events for members of the team hosted by the surgeon playing the proverbial role of “matriarch” or “patriarch” of the work family. For example, I host a “Team Bushnell Christmas Party” each year that encourages my “work family” to build and enjoy their relationships outside of the work environment. It has paid dividends in terms of attitude, efficiency, and performance at work – plus it is a ton of fun!

Conclusion

My friend and mentor Richard Hawkins has presented an amazing lecture he calls “The Journey” at numerous professional meetings (Hawkins, 2019). In it, he shares lessons learned over the course of his career that has spanned five decades. He concludes it with his favorite quote: “The journey home is never a direct route. It is in fact always circuitous and somewhere along the way we discover that the journey is more significant than the destination and that the people we meet along the way will be the traveling companions of our memories forever” (Hawkins, 2019). Our careers do truly constitute a journey of amazing privilege and responsibility, wherein we are invited into some of the most sacred spaces in the lives of our patients. As we seek constantly to improve our medical knowledge and surgical skills along this journey, we must likewise develop our abilities in the non-medical and personal realms. Success in our life depends on achieving and maintaining balance across these domains as our careers progress. While I certainly cannot claim to have perfected this art of balance, I can definitely say that my own journey has taken me to some amazing places. Never did the shy kid from a Southern college town ever expect to write an article of orthopedic career advice at the invitation of his Polish friend that grew up behind the Iron Curtain. But I hope that you’ve found some things within it that will make your journey just as special as mine.

Acknowledgements

Dr. Bushnell declares the following Conflicts of Interest:

None of which are related to the content of this manuscript.

Consulting fees, research support, and speaker fees from Smith + Nephew, Inc.

Consulting fees from Ossio, Inc.

Board/Committee Positions in American Shoulder and Elbow Surgeons (ASES), Georgia Orthopedic Society, Georgia Shoulder and Elbow Society

Ms. Leonard, Mrs. McEver, and Mr. Baudier have nothing to declare.

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27–29TH MARCH, 2025**

**RECURRENCE OF HUMERAL HEAD DECENTERING IN DIFFERENT GLENOID ANOMALIES
AFTER ANATOMICAL SHOULDER ARTHROPLASTY WITH CEMENTLESS FULL-METAL
GLENOID COMPONENTS**

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Introduction

Posterior or cranial decentering of the humeral head is considered a significant factor for early glenoid loosening due to asymmetric edge loading in cemented PE or metal-backed glenoids.

Aim

To determine whether correcting glenoid anomalies and reversing the articulating surfaces can contribute to improvements.

Material and methods

Among 80 shoulders (78 patients) treated with a novel system (stemless, cementless fixation of components in an anatomical shoulder arthroplasty with material reversal) between 2019 and 2022 (mean age 64), 21 cases exhibited preoperative posterior subluxation exceeding 80%, as determined by CT and 3D analysis. These cases were prospectively followed clinically and radiologically for 2–5 years. Glenoid dysplasia was excluded. The humeral head position was radiologically analyzed and clinical outcomes were assessed using the DASH and Constant scores.

Results

No recurrence of preoperative posterior decentering was observed in the mid-term follow-up, even in cases with significant anomalies ($\geq 10^\circ$ inclination and/or $\geq 20^\circ$ retroversion). Three patients exhibited clinical and sonographic signs of rotator cuff insufficiency, which was associated with a superior migration of the humeral head on radiographs. Apart from a low-grade infection with *Cutibacterium acnes*, no cases of glenoid loosening or radiolucent lines were detected. Bony integration of components and autologous grafts was observed even in severe B2-B3 deformities. There was no significant difference in clinical outcomes compared to patients with less preoperative decentering. No evidence of increased PE wear on the humeral head was found.

Conclusion

The structural stability of cementless ingrown full-metal glenoids may contribute to sustained centering, reduced PE wear and loosening rates and to functional improvement.

THE USE OF MIXED REALITY IN ARTHROSCOPIC ELBOW ARTHROLYSIS SURGERY. DESCRIPTION OF THE METHOD AND EARLY RESULTS

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Introduction

Elbow stiffness is a pathology that can have multiple causes. Degenerative changes are one of the most common, a specially in active population. Even a small restriction, of elbow movement particularly if painful can cause significant impairment of the patient's activity. Arthroscopic arthrolisis with removal of osteophytes have been effective treatment, however it relies on accuracy of bone resection. Mixed reality and holographic imaging offer potential guidance during these procedures.

Aim

This study aimed to evaluate the effectiveness of mixed reality guidance during arthroscopic elbow arthrolisis for degenerative contracture.

Material and methods

Study was based on prospective range of movement evaluation of 41 patients with degenerative elbow contracture underwent arthroscopic release, including resection of osteophytes and reshaping of fossae. 20 patients had the procedure done with mixed reality guidance (HOLO), and 21 without (NO-HOLO). Holograms were created from CT scans and used with a mixed reality viewing system (RSQ HOLO, RSQ).

Results

Range of motion was significantly better in the HOLO group both intraoperatively ($128^\circ \pm 10$ vs $121^\circ \pm 12$, $p = 0.016$) and at 1-week follow-up ($110^\circ \pm 17$ vs $96^\circ \pm 15$, $p = 0.041$). The HOLO group also had a smaller intraoperative extension deficit (2° vs 6° , $p = 0.02$). Gain of motion 6 months after arthroscopy was bigger in HOLO group by 11° ($p = 0.039$).

Conclusion

Mixed reality guidance enhances the restoration of range of motion during arthroscopic release of degenerative contractures and in the early follow-up period. It aids in identifying impinging osteophytes, contributing to more precise resection and better outcome.

ROTATOR CUFF TEAR WITH INCOMPLETE FOOTPRINT COVERAGE – EARLY RESULTS OF ARTHROSCOPIC REPAIR WITH THE USE OF BIOINDUCTIVE COLLAGEN MEMBRANE

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Introduction

Rotator Cuff tear with severe delamination and high retraction can lead to incomplete footprint coverage during arthroscopic repair. Despite advances in surgical techniques such injury is associated with a high risk of re-tear.

Aim

The aim of this study was to evaluate the outcomes of patients with rotator cuff injuries, with incomplete footprint coverage, arthroscopically operated with the use of bioinductive membrane.

Material and methods

24 patients (4 women) with traumatic supraspinatus tendon (SST) tears with or without damage to the infraspinatus tendon (IST), were enrolled to this study. Criteria included patients in whom complete tendon repair was possible, but with incomplete footprint coverage. All patients were treated arthroscopically with the use of bioinductive collagen membrane. Patients were assessed preoperatively at 4.6 and 12 months post-op. Each assessment included shoulder scales, isokinetic testing and imaging evaluation.

Results

Re-tear rate for isolated SST was 30%. For massive rotator cuff re-tear rate of SST was 42% and 14.5% for IST. Six re-tears were type 1 and three were type 2. In 10 patients who have fully healed, new tendon tissue has been observed in MRI at the site of the previous footprint defect. All clinical scales examined improved. Patients with isolated injury had better biomechanical results.

Conclusion

Rotator cuff repair with the use of bioinductive membrane is associated with significant clinical, biomechanical and radiological improvements. Bioinductive membrane placed partially on the tendon and partially on the footprint appears to stimulate tendon regrowth and reduce the number of type 2 re-tears.

MID-TERM RESULTS OF SUPERIOR CAPSULAR RECONSTRUCTION WITH THE LONG HEAD BICEPS TENDON REROUTING TECHNIQUE IN MASSIVE, IRREPARABLE ROTATOR CUFF TEARS

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Introduction

The gold-standard treatment option for massive irreparable rotator cuff tears (MIRCT) remains unknown.

Aim

To assess results of superior capsular reconstruction with biceps rerouting technique (LHBT-SCR) in patients with MIRCT.

Material and methods

Patients treated with LHBT-SCR due to MIRCT with at least 2 years follow-up were enrolled in this study. Shoulder ROM, pain in numeric rating scale (NRS) and shoulder function in Constant and SSI-ASES questionnaires were assessed. True-ap X-rays were analysed in terms of acromiohumeral distance (AHD) and cuff tear arthropathy (CTA) development in Hamada and Sirveaux classifications.

Results

The study group involved forty-five patients (11F, 34M) with the mean age of 65 years (50–77) and the mean follow-up of 52 months (24–100). One patient was excluded due to conversion to arthroplasty. The mean ROM was 150° for flexion, 148° for abduction and 35° for internal rotation. The average pain in NRS was 1.0. The mean functional result was 83.9 pts in SSI-ASES and 71.2 pts in Constant Score (pain 11.4/15 pts, ADL 16.6/20 pts, ROM 34/40 pts, strength 9/25 pts). The average AHD was 5.6 mm (2.0–8.7mm). CTA was assessed as grade 1 in 23, grade 2 in 14, grade 3 in 3 and grade 4 in 4 patients. Glenoid erosion was observed in 9 patients and assessed as grade 1 in eight and grade 2 in one patient according to Sirveaux classification.

Conclusion

In a mid-term observation LHBT-SCR provides excellent, pain-free ROM, despite persistent muscle strength deficits. During observation only 1 patient required conversion to RSA and 7 out of 44 patients developed significant CTA.

ASSESSMENT OF ELBOW PROPRICEPTION WITH INERTIAL MEASUREMENT UNITS- VALIDITY AND RELIABILITY STUDY

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Introduction

Proprioception is a key sensory function enabling individuals to perceive body position and movement. It is essential for optimal performance, particularly in athletes. However, accurately measuring proprioception remains a challenging task with the methods currently available.

Aim

This study assessed the reliability of elbow proprioception measurement using inertial motion sensors- IMU and validating IMU against other angle measurements methods.

Material and methods

Twenty healthy participants underwent active and passive proprioception assessments based on elbow joint position sense (JPS). Analyzed data was error of reproduction of joint position (ERJP). Angular measurements were performed using a single IMU (RSQ MOTION) and validated against BIODEX SYSTEM 4 moving frame.

Results

Inter-rater reliability for passive proprioception was high, with a Kendall's coefficient of 0.77 ($p < 0.05$) for both RSQ Motion sensors and BIODEX, while active proprioception measured with RSQ Motion sensors showed slightly lower reliability (Kendall's coefficient of 0.66, $p < 0.05$). Intra-rater reliability had similar results, with Kendall's coefficients of 0.74 for passive BIODEX proprioception examination, 0.75 for passive RSQ Motion sensor testing and 0.65 for active proprioception ($p < 0.05$) measured with RSQ Motion sensors. Bland-Altman analysis revealed that differences between the RSQ sensors and BIODEX were within the limits of agreement (LoA). Mean absolute value of the ERJP between RSQ sensors and BIODEX was 0.88° (95% CI: 0.79–0.98; SD: 0.71).

Conclusion

These results suggest that elbow joint position sense assessment methodology using IMU is reliable and accurate. The study serves as a background for further research of joint proprioception in the human body.

CAN WE PREDICT RECOVERY AFTER SHOULDER ARTHROSCOPY REPAIR BASED ON PATIENTS' NARRATIVES?

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Introduction

Shoulder instability and rotator cuff tears are the primary indications for arthroscopic surgery. Given the demanding nature of these conditions and their treatments, psychological factors likely influence recovery. Analyzing patients' narratives offers a simple and accessible method to assess their psychological status.

Aim

To identify elements of the narrative that have a statistically significant relationship with and may be predictors of recovery rates.

Material and methods

73 patients (36 with instability, 37 with rotator cuff tears) underwent self-reported questionnaires and functional and biomechanical testing four months after surgery. Outcomes were compared between groups. Homogeneous parameters (ASES, Constant, UCLA, Biodex Deficits) were included in subsequent analyses. Patients also provided written narratives about significant turning points in their lives, which were coded for agency and communion motives. Effect size (d) was used to analyse differences in statistically significant correlations between groups with varying agency and communion levels.

Results

Patients with strong fulfilled agency reported significantly less pain, with large differences observed in pain levels (up to dConstant Pain = 1.58, $p = 0.015$), overall recovery outcomes (up to dUCLA Total = 1.23, $p = 0.035$), and average power deficit (up to $d = 0.91$, $p = 0.047$). Conversely, strongly thwarted communion negatively impacted function (up to dConstant Function = 0.87, $p = 0.027$; dASES Function = 1.81, $p = 0.133$), increased related disability (up to dUCLA Total = 2.01, $p = 0.028$) and deficit in average power in internal rotation (up to $d = 1.81$, $p = 0.003$).

Conclusion

Fulfilled agency and thwarted communion in patient narratives may predict recovery outcomes, particularly pain and function. Strong agency appears to enhance pain resilience, while thwarted communion negatively affects the return to daily activities.

DYNAMIC ANTERIOR STABILIZATION USING LONG HEAD OF THE BICEPS TENDON IN ANTERIOR SHOULDER INSTABILITY – SHORT-TERM FOLLOW-UP RESULTS

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Introduction

Soft tissue stabilization procedures in anterior shoulder instability are associated with more important risk of recurrence than bony procedures. Dynamic anterior stabilization (DAS) with long head of the biceps (LHB) was introduced as a tool for the patients with risk factors, but with with no significant glenoid bone loss.

Aim

Aim of the study was to retrospectively investigate the efficiency and patient satisfaction after arthroscopic soft tissue stabilization including the reinforcement with DAS stabilization using LHB.

Material and methods

20 patients (14 males and 6 females) operated between 2018 and 2024 were included into the analysis. Mean age was 27 (14–46). Mean follow-up was 39 months (6–63) Patients were retrospectively questioned using SSV, VAS, WOSI and ASES questionnaires.

Results

Preoperative mean SSV was 65% (40–80%) and mean VAS 3 (0–8). Postoperative results increased to mean SSV of 91% (80–100) and mean VAS score of: 0.7 (0–4). Mean pooperative WOSI score was 11/100 (1–44) and mean ASES score was 97 (82–100). None of the patients had recurrence of instability. In 1 patient postoperative irritation of the axillary nerve was reported – it resolved spontaneously within 6 weeks.

Conclusion

Dynamic shoulder stabilization with LHB tendon provide satisfactory results in short-term follow-up and is a valuable tool in patients with anterior shoulder instability with no significant glenoid bone loss. No significant risk of the procedure was reported.

OPEN VERSUS ARTHROSCOPIC ELBOW ARTHROLYSIS FOR POST-TRAUMATIC ELBOW CONTRACTURE: EARLY PROSPECTIVE AND MID-TERM RETROSPECTIVE OUTCOMES WITH A MINIMUM 5-YEAR FOLLOW-UP

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Introduction

Elbow contracture is a common following elbow trauma. This condition significantly impairs activities of daily living.

Aim

This study aimed to compare outcomes of open versus arthroscopic elbow arthrolysis for post-traumatic elbow contracture.

Material and methods

Two groups of patients with arthroscopic – ASK (n = 61) and OPEN (n = 62) release of post-traumatic elbow contracture were followed prospectively for 6 months, with a final retrospective evaluation at a minimum 5-year follow-up.

Results

Preoperatively, ASK had significantly better range of motion (ROM) vs open, respectively: Extension 38.3° vs. 50° (p < 0.0001), Flexion 124.2° vs. 100.3° (p < 0.0001).

Postoperatively: No significant differences in intraoperative ROM were observed between groups. Final ROM and MEPS (Mayo Elbow Performance Score) were significantly better in the ASK group: Extension: 15° vs. 20.9° (p = 0.03), Flexion: 137.4° vs. 130.1° (p < 0.05), MEPS: 95.9 ± 17.9 vs. 87.3 (p = 0.0001).

Subgroup Analysis by Severity of Contracture:

- Severe-to-very severe contractures: Both techniques had comparable outcomes.
- Moderate-to-minimal contractures: The ASK group had significantly better ROM and ROM gains at both early (1 week post-op) and final follow-up: Extension: 140° vs. 134° (p = 0.001), ARC: 125.1° vs. 115.9° (p = 0.01), ROM gain: 45.8° vs. 35.9° (p = 0.023) and function- MEPS: (96.9 vs. 90.3, p = 0.004). OPEN group had greater loss of gained ROM (21.6° vs. 8.1°, p = 0.002).

Conclusion

Both open and arthroscopic elbow arthrolysis significantly improved ROM, function, and patient satisfaction in mid-term follow-up.

For moderate-to-minimal contractures, the arthroscopic technique demonstrated superiority, both in early and final assessments. Caution is required in drawing broad conclusions, as the groups were not entirely comparable, potentially reflecting diverse trauma severity.

RESULTS OF THE NERVE TRANSFERS TO RESTORE SHOULDER AND ELBOW FUNCTION IN TRAUMATIC UPPER BRACHIAL PLEXUS PALSY

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Introduction

Damage to the upper trunk of the brachial plexus, often caused by highenergy trauma, leads to significant functional impairment of the upper limb, resulting in paralysis of muscles critical for shoulder and elbow function. If spontaneous nerve regeneration does not occur within 3–6 months post-injury, surgical intervention, including nerve transfers, is recommended to restore function.

Aim

This study evaluates longterm outcomes of nerve transfer around shoulder and elbow, on adult patients with post-traumatic brachial plexus injuries.

Material and methods

Nerve transfer performed between 2013 and 2023 on 16 adult patients with brachial plexus injuries. The most common cause of injury was motorcycle accidents. Nerve transfers targeted shoulder and elbow function restoration, including transfer of the accessory nerve to the suprascapular nerve, the radial nerve branch to the triceps brachii to the axillary nerve, or the transfer of motor fascicles of the ulnar and median nerves (double Oberlin) to the brachialis and biceps brachii motor nerves.

Results

Postoperative results showed varying degrees of functional recovery. In shoulder, most patients achieved stabilization and partial restoration of active movement, with average flexion up to 92° and abduction up to 78°. In the elbow, full flexion with M4 strength was achieved in 64% of patients. In both the shoulder and the elbow, double nerve transfers yield better long-term outcomes than single transfers. Secondary procedures, such as tendon transfers, were required in some cases to improve limb strength.

Conclusion

Nerve transfers offer reliable outcomes in restoring upper limb function, although additional surgeries may be necessary in certain cases.

THE LATERALIZATION AND DISTALIZATION INDEX IS MORE RELIABLE THAN ANGULAR RADIOGRAPHIC MEASUREMENTS IN REVERSE SHOULDER ARTHROPLASTY

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Introduction

The lateralization shoulder angle (LSA) and distalization shoulder angle (DSA) are used to reproducibly measure lateralization and distalization after reverse shoulder arthroplasty (RSA). However, LSA and DSA may not offer a precise measurement of humeral lateralization and distalization and this relationship has not been explored.

Aim

The aim of this study was to evaluate the validity of these measurements and to propose new measurement methods to estimate implant lateralization and distalization.

Material and methods

3D models were constructed from computed tomography (CT) scans of 30 patients using a software platform. For each patient 24 different RSA modifications were created, resulting in 720 different RSA configurations. For each configuration LSA and DSA angles as well as lateralization and distalization distances were measured. Moreover, for each configuration two new measurements were done: the lateralization index (LI) and distalization index (DI). Correlations of the lateralization and distalization parameters were evaluated between measurements.

Results

Weak correlations were founded between LSA and lateralization ($r = 0.36$, $p < 0.01$), whereas moderate correlations were observed between LI and lateralization ($r = 0.72$, $p < 0.01$). No significant correlations were found between DSA and distalization ($r = 0.17$, $p = 0.113$). In contrast, moderate correlations were identified between DI and distalization ($r = 0.69$, $p < 0.01$).

Conclusion

LI and DI are more reliable methods to estimate implant lateralization and distalization compared to angular radiographic measurements. However, the prognostic significance in predicting clinical outcomes after RSA remains unknown.

EHLERS-DANLOS SYNDROME AND HYPERMOBILITY SPECTRUM DISORDER SHOULDER INSTABILITY PROFILE

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Introduction

Despite a recent increase in knowledge the management of atraumatic shoulder instability is still a major challenge. Acquiring knowledge of the first symptoms may, in the future, lead to a fast-track diagnosis or the elimination of risk factors that could contribute to the further development of instability.

Aim

The aim of the study was to assess patients with shoulder instability among EDS and HSD.

Material and methods

132 patients with EDS initial diagnosis were examined according to the study inclusion criteria. 45 patients with shoulder instability – 36W and 9M were examined according to their main complaints and undergo: hypermobility assessment, shoulder clinical examination and medical history summary such as: age during first shoulder dislocation, recurrency of the instability, pain during and after dislocation. To assess patients condition DASH and ASES questionnaires were taken.

Results

84% of examined patients experienced first shoulder dislocation around 13–17 years old. Mean number of dislocations varied between 20–60 with low pain level during dislocation (VAS: 3). We observed significant increase of the pain level after (> 1–2 days) the dislocation (VAS: 6–7). There was significant correlation ($p < 0.05$) between number of dislocations and recurrency of the instability and MRI results. 78% of patients MRI results revealed labrum tears and SLAP injury. DASH and ASES questionnaires revealed significant decrease of patients quality of life.

Conclusion

There are several symptoms which may lead to the diagnosis of shoulder instability among patients with EDS and HSD such as: age during first dislocation or pain characteristic.

PRELIMINARY RESULTS OF THE TREATMENT OF COMPLEX RADIAL HEAD FRACTURES WITH BIPOLAR RADIAL HEAD ENDOPROSTHEOPLASTY TYPE KPS

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Introduction

Radial head fractures are frequently encountered in clinical practice and pose significant challenges due to their negative effects on the stability and function of the elbow joint.

Aim

The purpose of this study was to evaluate the outcomes of treating complex radial head fractures using KPS type, bipolar radial head endoprosthesis.

Material and methods

A single-center retrospective analysis was conducted, including patients with radial head fractures (primarily Mason type III and IV) treated surgically between 1998 and 2023, for whom endoprosthesis was the sole viable treatment option.

The study cohort comprised 460 patients who underwent surgery at least two years before the research began. Treatment protocols were analyzed, and patients were re-examined to assess the final treatment outcomes. Functional outcomes were evaluated through range of motion (ROM) measurements, pain scales, the Mayo Elbow Performance Score (MEPS), and the American Shoulder and Elbow Score (ASES-E). Diagnostic imaging, including radiography, dynamic computed tomography (CT), and ultrasound, was also utilized to further evaluate joint stability.

Results

Preliminary results indicate that bipolar radial head endoprosthesis type KPS is an effective method for treating complex radial head fractures, yielding satisfactory functional outcomes.

Conclusion

This study focuses on identifying potential factors that influence the results of the KPS endoprosthesis system to improve preoperative qualification, surgical protocols, and post-operative management.

ARTHROSCOPIC TREATMENT OF LOCKED POSTERIOR DISLOCATIONS

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Introduction

Posterior shoulder dislocation (PSD) is rare injury, often neglected in initial diagnosis. Untreated cases after three weeks become chronic and locked, impossible to treat with closed reduction. This pathology is associated with posterior labral tear and Perthes fracture which requires challenging surgical treatment.

Aim

The aim of this study was to evaluate the outcome of arthroscopic treatment in locked posterior shoulder dislocations.

Material and methods

Patients with locked PSD treated in our hospital in 2008–2024 were retrospectively analyzed. Treatment methods: closed or open reduction of GHJ, arthroscopic posterior labral repair with McLaughlin procedure (classic or modified). Functional outcomes were measured post-operatively: range of motion (ROM) and pain measurement in VAS (visual analogue scale). Failure was defined as a re-dislocation after surgery.

Results

Data of 19 patients was analyzed. Mean age was 45.7 years (range 23 to 73) and mean follow-up was 25.6 months (range 1–144). There was higher proportion of male patients. Etiology of PSD was related with injury (n = 15), seizures (n = 3) and electric shock (n = 1). The mean duration of locked dislocation was 11.1 weeks (range 3 to 36). Bilateral dislocations-3 cases. Reduction of dislocation was managed: arthroscopy assisted (n = 13), closed (n = 4), open reduction (n = 2). 16 patients were treated surgically. Arthroscopic posterior labral repair was performed in 9 cases, McLaughlin procedure classic in 13, modified in 4 cases. Bilateral arthroscopy-2 patients. 1 patient required posterior bone block and 1 primary RSA. All 19 patients reported no recurrent dislocation. Follow-up ROM: ER significantly improved from mean -10° to 36° in adduction, ABD from mean 28° to 70° ($p < 0.01$). FF increased from 64° to 146° ($p < 0.01$).

Conclusion

Arthroscopic closed reduction with labral repair and McLaughlin procedure (classic or modified) for patients with neglected locked posterior shoulder dislocation is an effective way of managing this complex and rare injury.

VALIDATION AND RELIABILITY OF SCAPULAR MORPHOLOGY ASSESSMENT USING MIXED REALITY

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Introduction

Recent advancements in Augmented (AR) and Mixed Reality (MR) have significantly impacted the orthopedic field, with hope of holographic tools to enhance surgical precision. This study validates and explores the reliability of a specially designed software tool, integrated with HoloLens2 for measuring anatomical structures of the shoulder girdle in orthopedic surgery.

Aim

The purpose of this study was to validate and investigate the reliability of RSQ Holo software as a measurement tool integrated with Microsoft HoloLens 2 device.

Material and methods

Fifty-one right human scapulas obtained from the Department of Zoology at Poznan University of Life Sciences were measured directly using a caliper, on 2D and 3D CT scans and with holographic instruments (RSQ Holo system). Glenoid height, glenoid width and scapular width were measured. Imaging methods were validated against direct caliper measurements. Intra-rater and inter-rater reliability was assessed among four testers.

Results

Descriptive statistics indicated minimal measurement differences across all groups, with the majority of differences being under 1 mm. Comparison graphs, and descriptive statistics showed that in glenoid height and glenoid width RSQ Holo measurements are the closest to direct measurements. Scapula width measurements done with every technique were equal. ICC revealed excellent intra-rater reliability for scapula width (0.96) and glenoid width (0.91), and good reliability for glenoid height (0.85). Inter-rater reliability also showed promising results, particularly for scapular width (0.91) and glenoid width (0.78), although glenoid height (0.72) showed moderate agreement.

Conclusion

Findings demonstrate that RSQ Holo software provides accurate and consistent measurements, supporting its potential use in preoperative planning and intraoperative navigation.

ADVANCED MRI PROTOCOL FOR LATERAL EPICONDYLITIS: DIAGNOSTIC ACCURACY AND TREATMENT MONITORING

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Introduction

Lateral epicondylitis (tennis elbow) is a degenerative tendinopathy of the common extensor tendon (CET), often affecting individuals engaged in repetitive upper-limb activities. While clinical diagnosis is standard, MRI enables objective assessment of tendon pathology and treatment response.

Aim

This study aimed to develop a standardized MRI protocol for diagnosing and monitoring lateral epicondylitis, assess its reliability, and evaluate platelet-rich plasma (PRP) injections' efficacy.

Material and methods

A double-blind, randomized, placebo-controlled study was conducted on 71 patients with chronic lateral epicondylitis. MRI scans were performed using a 3T scanner in the "Superman position," assessing CET integrity, tendon tears, soft tissue edema, and collateral ligament abnormalities. Patients received either leukocyte-rich PRP (LR-PRP), leukocyte-poor PRP (LP-PRP), or saline injections. MRI findings were correlated with clinical outcomes at six months. Interobserver reliability was measured using the intraclass correlation coefficient (ICC).

Results

The MRI protocol demonstrated excellent reliability (ICC > 0.90). LR-PRP significantly reduced tendon tear size and soft tissue edema, whereas LP-PRP and saline injections resulted in partial improvements. MRI findings correlated with clinical recovery, supporting its use in treatment monitoring.

Conclusion

This study presents a reproducible MRI-based assessment technique for lateral epicondylitis, enhancing diagnostic precision and treatment evaluation. Findings highlight the potential of LR-PRP in tendon healing and reinforce MRI's role in guiding clinical decisions.

IMPACT OF ADIPOSE-DERIVED AND AMNION-DERIVED MESENCHYMAL STEM CELLS ON MASSIVE ROTATOR CUFF TEARS IN AN ANIMAL MODEL

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Aim

Assessment of the ability of amnion-derived mesenchymal stem cells (anMSCs) and adipose-derived mesenchymal stem cells (adMSCs) to alter the process of fatty infiltration (FI) in massive rotator cuff tears in animal model.

Material and methods

Research comprised of pilot and main studies. Pilot study focused at estimation of FI (≥ 3 on the Goutallier scale) and included an analysis of 10 New Zealand, White Rabbits. Main study was performed on 52 species with rotator cuff tear ≥ 3 ; supraspinatus (SS) and infraspinatus (IS) muscles were randomly injected with 2ml of anMSCs ($n = 14$), adMSCs ($n = 13$), and 0.9% NaCl ($n = 25$). After 4 weeks, both muscles of 52 animals were resected. Histopathological analysis was performed with a Goutallier scale assessment by two independent researchers.

Results

Preliminary study indicated mean FI in 8th week 1.89(SD=0.80) in 10th 3.14 (SD=1.1), statistically significant difference was stated between the 4th, 6th, 8th, and 10th weeks ($p < 0.00$). In main study, mean FI in anMSCs group equaled: for IS = 2.69 (SD = 1.38), SS = 0.55 (SD = 0.52), in adMSCs group IS = 3.38 (SD = 0.96), SS = 1.00 (SD = 1), for control group IS = 3.24 (SD = 0.66), SS = 0.72 (SD = 0.74). Both, SS and IS differed significantly in amount of developed fatty infiltration; anMSCs ($p < 0.004$) and adMSCs ($p < 0.0001$). No statistical significance was observed between control group and study groups for SS ($p = 0.3238$) and IS ($p = 0.3090$) respectively. There was also no significant difference between adMSCs vs control (SS $p = 0.42$, IS $p = 0.38$), anMSCs vs control (SS $p = 0.56$, IS $p = 0.39$).

Conclusion

Neither anMSCs nor adMSCs demonstrated the ability to significantly alter the process of the fatty infiltration of the rotators cuff muscles. However, fatty infiltration level differed between SS and IS muscles.

HYPERMOBILITY, INSTABILITY AND PROPRIOCEPTION DEPENDENCY IN SHOULDER INSTABILITY CASES

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Introduction

Management of resultant shoulder instability is still a major challenge for medical practitioners. One of the challenges is to examine the relation between hypermobility and instability because it is often repeated that hypermobility lead to instability and its responsible for patients surgery and rehabilitation failure.

Aim

The aim of the study was to assess the relation between hypermobility and instability among patients with shoulder instability.

Material and methods

Three groups of patients were classified to the study: hypermobile with atraumatic shoulder instability (n = 31), hypermobile without shoulder instability (n = 27) and traumatic shoulder instability (n = 30). As a control group we examined 30 healthy subjects without any upper limb trauma. The examination was composed of clinical examination, hypermobility assessment – Beighton score and joint position sense examination as a part of proprioception examination.

Results

There was no significant difference between error of active reproduction sense (EARJP) between instability groups. The result in hypermobile atraumatic shoulder instability group was 13.2 +/- 3.2, and in nonhypermobile traumatic group was 11.7 +/- 4.6.

There was no significant correlation between hypermobility and EARJP among patients. There was significant difference ($p < 0.05$) between both groups and hypermobile patients without instability and control group. The EARJP in hypermobile group with stable shoulder was 7.5 +/- 2.1 and the result was significantly higher in comparison with control group.

Conclusion

Instability significantly increases the proprioception deficit among patients with shoulder instability. Hypermobility does not always have to mean joint instability.

REVERSE SHOULDER ARTHROPLASTY WITH MODULAR GLENOID BASEPLATE: CLINICAL AND RADIOLOGICAL OUTCOMES OF THE FIRST 20 PATIENTS

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Introduction

Reverse shoulder arthroplasty (RSA) has become a widely adopted technique for managing various shoulder pathologies. Modular glenoid systems (MGS) offer a range of component choices, allowing the procedure to be tailored to individual patients' needs. This study evaluates the outcomes, of the first 20 cases performed using an RSAMGS.

Aim

To assess the clinical and radiological outcomes of RSA using an MGS and determine the repeatability of these results.

Material and methods

A retrospective analysis was conducted on 20 patients who underwent RSAMGS. Clinical outcomes were assessed using forward flexion (FF), abduction (ABD), external rotation (ER), internal rotation (IR), and the Constant Score (CS). Radiological evaluation included B-angle, lateralization shoulder angle (LSA), and distalization shoulder angle (DSA). The patients were followed for an average of 9.95 ± 2.27 months.

Results

Significant improvements were observed across clinical parameters, with mean FF of $153.16^\circ \pm 15.02^\circ$, ABD of $109.47^\circ \pm 10.79^\circ$, ER of $20.53^\circ \pm 6.21^\circ$, and IR of $84.74^\circ \pm 3.26^\circ$. The mean Constant Score was 78.53 ± 3.26 . Radiological findings demonstrated mean LSA of $84.55^\circ \pm 4.27$, DSA of $51.25^\circ \pm 3.85$, and B-angle of $0.11^\circ \pm 1.66$. Mean lateralization on glenoid side was 3.89 ± 1.24 mm. No short- or mid-term postoperative complications were observed.

Conclusion

RSA with an MGS provides reliable and repeatable clinical and radiological outcomes. These findings support the use of this modular design in RSA, with the potential to deliver predictable results tailored to individual patient needs. Further studies are recommended to validate these initial results.

ROTATIONAL OSTEOTOMY OF THE RADIUS IN THE TREATMENT OF CONGENITAL RADIOULNAR SYNOSTOSIS

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Introduction

Congenital radioulnar synostosis (CRUS) is a rare developmental anomaly. In most patients, the forearm is fixed in pronation, causing significant functional impairment.

Aim

The aim of the study is to evaluate the effectiveness of rotational osteotomy of the radius in improving upper limb function and range of motion in patients with congenital radioulnar synostosis, as well as to assess the safety and long-term outcomes of the procedure.

Material and methods

The study involved 5 patients with CRUS who underwent rotational osteotomy of the radius. The procedure included rotating the forearm to 90° supination and applying a plaster cast. Postoperatively, range of motion and upper limb function were assessed.

Results

Six forearms in five patients with CRUS, who underwent rotational osteotomy of the radius, were monitored for an average of 3 years postoperatively. Preoperatively, the forearm was positioned in approximately 50° pronation (range: 30°–90°). The osteotomy was performed at the attachment site of the pronator teres muscle to the radial shaft. The forearm was then rotated to position the hand in 90° supination, and a plaster cast was applied. At the final follow-up visit, the hand was able to achieve an average range of motion from 25° pronation to 63° supination.

No neurological or vascular complications were observed postoperatively. A significant improvement in the ability to perform daily activities was noted, and all patients were satisfied with the surgical outcomes.

Conclusion

Rotational osteotomy of the radius is a technically simple, safe procedure that provides good functional results.

SHOULD BEIGHTON SCORE BE A USEFUL TOOL FOR SHOULDER INSTABILITY ASSESSMENT?

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Introduction

Beighton score (BS) is wide known scale which enables the laxity assessment of children and adults. The score is very often used during clinical examination of patients with shoulder instability, and it is frequently suspected that patients with higher BS have increased tendency to develop the shoulder instability.

Aim

The aim was to assess Beighton score results to the instability symptoms among patients with hypermobility and shoulder instability.

Material and methods

40 patients with diagnosed hypermobility (34W and 6M) with age 12–48 have participated in the study. Patients were assessed according to their symptoms and BS results. The questionnaire was constructed according to their results performed by specialist, and they were asked to perform the Beighton score tasks individually. Additionally patients reported their symptoms and instability issues.

Results

The BS was pointing out the hypermobility among 32 patients (> 4). There was no significant difference ($p > 0.05$) between the BS assessed by professional and patients self-assessment. 90% of examined patients reported subjective shoulder instability issues and 56% reported shoulder dislocations more than 3 times in their life. There was no significant difference ($p > 0.05$) between the BS assessed by professional and patients self-assessment. 90% of examined patients reported subjective shoulder instability issues and 56% reported shoulder dislocations more than 3 times in their life.

There was no significant difference between BS and patients shoulder instability diagnosis or number of shoulder dislocations. There was no correlation between BS or its components and the shoulder instability ($p = 0.66$). There was no correlation between BS and the number of shoulder dislocations.

Conclusion

Beighton score do not represent significant relation with shoulder instability symptoms among patients with soft tissue genetic mutation. Because of instability complex biomechanical changes BS should be considered only as soft tissue supplemental assessment.

ANALYSIS OF THE EFFECTS OF THE ULTRASOUND-GUIDED SUPRASCAPULAR NERVE BLOCK ON ROTATOR CUFF LESION

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Introduction

Rotator cuff lesions are common causes of shoulder pain. When not treated effectively, the functional loss associated with pain affects the quality of life. Conservative treatment is often prescribed for small lesions or as a preparatory step before surgery in larger ones.

Aim

This study presents a prospective observational comparison of the effects of ultrasonography (USG)-guided suprascapular nerve block versus physical therapy in conservative treatment of rotator cuff lesions.

Material and methods

The comparison involved three groups: physical therapy alone, nerve block alone, and nerve block followed by physical therapy. Patients were qualified for the study after a physical examination and MRI assessment. Based on MRI findings, the Patte and Goutallier scales were evaluated. Patients reported their pain and functionality using the VAS and WORC scales. Assessments were conducted at 2, 6, and 10 weeks after the initial visit. Each group consisted of 40 patients.

Results

Before treatment, patients presented with a mean VAS score of 7.8 and a mean WORC score of 39.6. The primary physical examination findings included limited internal rotation and abduction (mean values: 49.2° and 84.3°, respectively). The best outcomes across all groups were observed in patients with Patte grade I lesions, particularly in the group receiving a combination of nerve block and physical therapy (VAS 2.9, WORC 82.7).

Conclusion

In the short-to-medium term, pain control, shoulder functionality, and patient satisfaction were found to be higher in patients treated with a suprascapular nerve block combined with physical therapy for shoulder pain caused by rotator cuff lesions.

PERFORATOR AND PROPELLER FLAPS FOR MANAGEMENT OF DEEP TISSUE DEFECTS AROUND THE ELBOW AFTER TOTAL ELBOW ARTHROPLASTY AND OSTEOSYNTHESIS

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Introduction

Management of deep soft tissue defects can be challenging for the orthopaedic-trauma surgeons. If possible, to get the best results, free flaps provide the best coverage by plastic surgeons, thus having an orthoplastic approach. As plastic- and microsurgions are not everywhere available, local flaps can be a good choice of treatment, without microsurgical knowledge for the coverage of elbow defects, that can occur after total elbow arthroplasty or osteosynthesis.

Aim

Our aim is to present two possible flap options for the treatment of elbow deep tissue defects without microsurgical knowledge.

Material and methods

Between 2022 and 2024 there were 4 patients, who needed more complex tissue coverage as a split thickness graft, that means a fasciocutan flap. Most of the flaps were lateral arm reverse flow flaps, and one patient had a radial artery pedicled forearm flap.

Results

In our results, from the 4 patients all of them were males, age between 35 and 70 years. Only elbow soft tissue defects were included in the cohort, 3 patients had a defect regarding the olecranon, 1 at the radial aspect of the elbow. Out of the 4 local, perforator-based flaps we had perfect outcomes in 3 cases. In one case, we lost our lateral forearm flap, and we needed to treat that with an anterolateral thigh free flap with the help of plastic surgeons.

Conclusion

Local, propeller flaps or perforator flaps can be a safe and reliable method for treating soft tissue defects around the elbow if orthoplastic approach is not available with microsurgical technique.

FULLY ARTHROSCOPIC TRANSFER OF LATISSIMUS DORSI AND TERES MAJOR TENDON IN MASSIVE NOT-REPERABLE ROTATOR CUFF TEAR IN PATIENTS WITH PSEUDOPATALYTIC SHOULDER – TECHNIQUE DESCRIPTION AND COST ANALYSIS – IS IT WORTH IT?

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Introduction

Massive not-reperable rotator cuff tears in patients without glenohumeral joint arthritis remain the problem for shoulder surgeons. Several options are offered to improve patients' shoulder function including tendon transfers which are difficult procedures and their benefits comparing to more simple techniques remains debatable.

Aim

The goal of this study was to present the fully arthroscopic technique of the latissimus dorsi (LD) and teres major (TM) tendon transfer. This arthroscopic procedure is time consuming and requires advanced surgical skills. The goal was to present both technical aspects and financial and logistics effort required to perform this operation.

Material and methods

Three male patients (62, 63 and 68 years old) with massive, not-reperable rotator cuff tears with flexion and rotation shoulder pseudoperesis were operated on by a single surgeon. The arthroscopic technique was divided into 3 steps including posterior compartment muscles visualisation, anterior compartment tendons liberation and transfer posteriorly and finally partial reconstruction of the posterior rotator cuff associated with transferred tendons fixation.

Results

2 patients were already very satisfied with the results. They reported no pain and function improvement. Their range of motion was average 120/120/10/LS with no external rotation lag sign. The time of surgery was from 240 to 340 minutes, 3 to 5 implants were used. The average cost was evaluated about 23 000 PLN (> 5000 Euros) without the surgeon fee.

Conclusion

Fully arthroscopic LD and TM transfer is expensive and time-consuming procedure. It can be done fully arthroscopically, but its real benefit should be thoroughly evaluated comparing to other less complicated procedures.

ARTHRODESIS IN TREATMENT OF SHOULDER INSTABILITY IN A PEDIATRIC PATIENT

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Karola Marcinkowskiego w Poznaniu

Introduction

Hypermobility, as an increase in the range of motion within a joint, occurs in the course of diseases with connective tissue disorders. Susceptibility to injury can result in joint instability, including recurrent dislocations and pain. In cases of severe hypermobility, where traditional rehabilitation methods prove ineffective, surgical interventions are considered.

Aim

This case report presents the results of surgical treatment of the right shoulder instability in a 9-year-old female with hypermobility and habitual dislocations of this joint in the course of Ehlers-Danlos syndrome.

Material and methods

A 9-year-old female wheelchair user with hypermobility due to Ehlers-Danlos syndrome, experiencing significant right shoulder instability and right brachial plexus birth palsy. Instability caused habitual dislocation of the right shoulder since birth with a high pain component, preventing effective rehabilitation. After establishing the indications, shoulder arthrodesis was performed, including stabilization with Kirschner wires and supplementation with bone grafts. Nine months post-surgery, range of motion, pain, and radiological evaluation were conducted.

Results

The arthrodesis resulted in the stabilization of the shoulder. Nine months after the procedure, no passive motion and a significant reduction in shoulder pain were observed. Diagnostic imaging did not provide sufficient evidence to confirm permanent bone fusion in the joint.

Conclusion

Arthrodesis achieved very good outcomes in this patient. Despite restricting the joint's mobility, the procedure significantly improved the patient's condition and enhanced the quality of her life.

HOW NOT TO MISS THE CORRECT DIAGNOSIS OF OSTEOLYTIC BONE DESTRUCTION OF UNKNOWN ORIGIN. A CASE OF A 49-YEAR-OLD WOMAN WITH OSTEOLYTIC DESTRUCTION OF THE HUMERAL HEAD

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Introduction

Bone osteolytic lesions can be caused by benign, malignant, or infectious processes. The differential diagnosis for these conditions is important but can also be challenging. One rare yet significant condition to consider during the diagnostic process is tuberculosis (TB) of the bone.

Aim

The diagnostic process for bone tumours is complex, highlighting the importance of differential diagnostics, particularly when considering infections caused by tuberculosis bacilli. It is crucial to collect tuberculosis samples when osteolytic bone changes of unknown origin occur, as tuberculosis should be considered in such cases.

Material and methods

An analysis of the literature and a clinical case involving a 49-year-old woman is presented. The patient was referred for a suspected tumour in the distal humerus. Imaging studies, including X-rays, MRI, and PET scans, suggested the possibility of a malignant bone lesion. A thorough examination of the patient's clinical history was conducted, and the differential diagnosis was broadened to consider the potential for bone tuberculosis.

Results

Bacteriological and histological examination of the biopsy tissue confirmed the diagnosis of bone tuberculosis, which caused extensive destruction of the humeral head and resulted in severe disability of the arm. The patient was referred for pharmacological therapy.

Conclusion

This case emphasizes that other diseases, such as tuberculosis (TB), can initially mimic osteolytic bone tumours, which can delay the diagnostic and treatment process. A diagnostic algorithm for osteolytic bone lesions of unknown origin could be a valuable tool in establishing an accurate diagnosis.

RADIAL NERVE ENTRAPMENT WITH TOTAL PARESIS ASSOCIATED WITH SUPRA-CONDYLAR HUMERUS FRACTURE IN 6 YEARS OLD BOY. CASE REPORT. REVIEW OF ACTUAL LITERATURE ABOUT THE TOPIC

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Introduction

In the years 2021–2023, 20 children with sequelae after supracondylar humerus fracture were admitted to the Department.

Among them were cases: varus-position healed fractures (treated with French osteotomy), Volkmanns contractures (in two cases free neurovascular transfer of gracilis muscle to lost FDS and FDP muscles was performed), 3 cases of children with ulnar neuropathy (neurolysis were performed with full recovery), 1 case with the median nerve neuropathy (neurolysis of the nerve was performed resulting in incomplete return of sensory nerve function). Radial neuropathy was the cause of 2 admissions, where – one underwent osteosynthesis of a supracondylar fracture without neurolysis of the nerve whose function was fully restored in 4 months. The second child underwent neurolysis of the nerve after healed fracture, but complete nerve entrapment needed excision of the nerve and repair in form of suturing end to end.

Aim

Presentation of a very rare case: radial nerve paresis because of nerve entrapment in supracondylar humerus fracture in a child.

Material and methods

Case presentation. Presentation of actual english literature review about the topic.

Results

The excellent result of radial nerve repair “end to end” is presented.

Conclusion

Diagnostic with ultrasound and/or MRI, supported with ENG may be with some help, but not necessary conclusive. In lack of recovery after 4–6 months nerve revision should be performed.

LONG HEAD OF THE BICEPS TENDON AUGMENTATION (LHBT+) ENHANCED WITH A BIO-INDUCTIVE COLLAGEN IMPLANT (REGENTEN) FOR MASSIVE AND RETRACTED ROTATOR CUFF TEARS

Hubert Laprus, Bartłomiej Juszcak, Aleksander Łapaj, Grzegorz Słota
Szpital Św Łukasza, Bielsko-Biała

Introduction

Massive and retracted rotator cuff tears (RCTs) are challenging to treat, with high rates of re-tear. Current surgical techniques strive to restore full function by addressing biomechanical complexities of these injuries. Additional use of long head of the biceps tendon augmentation (LHBT+) and bio-inductive implants may lower the re-tear rate by promoting healing of the construct.

Aim

To evaluate the efficacy and safety of a novel surgical technique combining double-row rotator cuff repair, LHBT+ and a bio-inductive collagen implant (REGENTEN) for the treatment of massive and retracted RCTs.

Material and methods

Four patients with massive and retracted RCTs (defined as involving at least two full-thickness tendons, retracted to degree 3 by Patte classification) underwent the combined surgical procedure. Post-operative assessment included range of motion, pain scores (Constant scale), and MRI imaging to assess tendon healing (Sugaya scale).

Results

All four patients demonstrated improved ROM and elimination of pseudo-paralysis with improved Constant Scores (68–86 points). Three of four patients exhibited satisfactory tendon healing on MRI (Sugaya scale 1–3). One patient showed no healing despite maintained painless function. No re-tears were observed during 7–16 months follow-up in all patients.

Conclusion

This novel surgical approach combining mechanical properties of double-row, LHBT+ repair along with bio-inductive collagen implant showed clinical outcomes in the treatment of massive and retracted RCTs. Collagen patches are hoped to promote tissue healing in retracted RCTs, though evidence supporting their effectiveness is still limited and studies with longer follow-up and larger population are necessary.

ARTHROSCOPIC MUSCLE ADVANCEMENT AND BICEPS TENDON AUGMENTATION FOR MASSIVE RETRACTED ROTATOR CUFF RE-TEARS

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Introduction

Revision rotator cuff surgeries are particularly critical as they address failures from initial repairs, which can arise from various factors. Additionally, in cases of massive rotator cuff revision repair, new challenges such as tendon quality, retraction, stiffness, and fatty atrophy must be addressed.

Aim

To present a new technique of arthroscopic muscle advancement combined with biceps tendon augmentation as a revision strategy for complex rotator cuff re-tears.

Material and methods

Two patients, aged 36 and 67 years, with massive and retracted postero-superior rotator cuff re-tears, underwent surgery. They were operated on two years after the initial procedure and six months, respectively. Post-operative functional assessments were performed using the Constant scale (CS). Tendon healing was evaluated using the Sugaya scale (SS) via MRI imaging.

Results

Follow-up for both patients was conducted at two months post-surgery. Both patients demonstrated clinical improvement; the younger patient increased from 64 to 78 points on the CS, while the older patient improved from 62 to 84 points. MRI results indicated no healing of the supraspinatus tendon in the younger patient (SS 5) and partial healing of the infraspinatus tendon (SS 3–4). In contrast, the older patient exhibited complete healing of both the supraspinatus and infraspinatus tendons (SS 2).

Conclusion

The new technique of arthroscopic muscle advancement combined with biceps tendon augmentation shows promise in treating massive and retracted revision rotator cuff tears, especially in instances where traditional methods without muscle advancement result in irreparability. However, longer follow-up and larger studies are necessary to confirm the long-term efficacy of this technique.

MULTIFOCAL FRACTURES OF UPPER LIMB TREATED WITH ORTHOSIS, PROSTHESIS AND PLATE

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Introduction

Trifocal fractures are rare entity as statistical research shows.

Aim

We would like to present a case of a patient, who were admitted to our department due to triple level fractures of upper limb and present applied treatment - orthosis, prosthesis and LCP plate and Kirschner pin.

Material and methods

The patient (F, 88 years old) suffered a fall in 11.2023 from her own height as a result of tripping and supporting with the upper right limb. She reported to the Emergency Department, where after clinical examination and routine radiological process the following fractures were stated: fracture of the acromial end of clavicle, comminuted transarticular fracture of the distal humerus, comminuted fracture of the distal radius and the head of ulna. The X ray results show characteristic features of osteoporosis. The injury was of a closed nature, there were no features characteristic of hand tendons laceration, distal blood supply or nerves damage. At the very start patient was treated with external fixation of elbow and wrist and after 2-days period treatment plan was proposed, to which the patient agreed: conservative treatment of clavicle, total elbow arthroplasty and open reposition of the radius with the internal fixation using LCP devices and stabilization of the ulna using a Kirschner pin.

Results

X-rays performed during treatment process and after 12 months follow up will be presented along with short video and photos of patient's ROM and results of functional questionnaires.

Conclusion

Distal humerus fractures treated with total elbow prosthesis still might have satisfactory final result.

ARTHRODESIS IN TREATMENT OF SHOULDER INSTABILITY IN A PEDIATRIC PATIENT

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im. Karola Marcinkowskiego w Poznaniu

Introduction

Hypermobility, as an increase in the range of motion within a joint, occurs in the course of diseases with connective tissue disorders. Susceptibility to injury can result in joint instability, including recurrent dislocations and pain. In cases of severe hypermobility, where traditional rehabilitation methods prove ineffective, surgical interventions are considered.

Aim

This case report presents the results of surgical treatment of the right shoulder instability in a 9-year-old female with hypermobility and habitual dislocations of this joint in the course of Ehlers-Danlos syndrome.

Material and methods

A 9-year-old female wheelchair user with hypermobility due to Ehlers-Danlos syndrome, experiencing significant right shoulder instability and right brachial plexus birth palsy. Instability caused habitual dislocation of the right shoulder since birth with a high pain component, preventing effective rehabilitation. After establishing the indications, shoulder arthrodesis was performed, including stabilization with Kirschner wires and supplementation with bone grafts. Nine months post-surgery, range of motion, pain, and radiological evaluation were conducted.

Results

The arthrodesis resulted in the stabilization of the shoulder. Nine months after the procedure, no passive motion and a significant reduction in shoulder pain were observed. Diagnostic imaging did not provide sufficient evidence to confirm permanent bone fusion in the joint.

Conclusion

Arthrodesis achieved very good outcomes in this patient. Despite restricting the joint's mobility, the procedure significantly improved the patient's condition and enhanced the quality of her life.

KNOTLESS STABILISATION OF HAHN-STEINHAL CAPITELLUM FRACTURE – NOVEL TECHNIQUE

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Introduction

Fractures of the capitellum often result in substantial osteochondral fragments requiring internal fixation to restore the anatomical structure of the elbow joint. Accurate reduction is crucial to ensure optimal articular congruence and to minimize the risk of post-traumatic arthrosis. Various techniques have been described for the fixation of these injuries, including metallic screws, bioabsorbable screws, bioabsorbable implants, and suture-based devices.

Aim

This case report presents a surgical method for fixing a capitellum chondral fracture using knotless all-suture anchors – a technique previously described only for knee osteochondral lesions.

Material and methods

The patient was a 40-year-old male who sustained an elbow extension injury. He was qualified for the procedure after X-ray and CT imaging.

Results

The surgery was performed under general anesthesia using a lateral approach to the elbow. After visualizing the fracture, reduction was performed. Two opposing anchors were stabilized in the bony bed of the humeral fracture. The opposite threads were secured within the knotless mechanism, creating an interconnection that provided final stabilization of the fracture. Postoperatively, the range of motion (ROM) was fully restored. The follow-up period lasted 6 months, during which X-ray and CT evaluations confirmed successful outcomes. Full recovery was achieved.

Conclusion

Fixation of traumatic osteochondral injuries with suture anchors is a reliable and effective technique, offering stable fixation of fracture fragments. This approach facilitates early joint mobilization while reducing the need for additional surgical interventions.

NANOSCOPIC LHBT TENOTOMY AMONG ELDERLY – A FEASIBILITY STUDY

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Introduction

The pathology of the long head of the biceps in elderly patients is an indication for biceps tenotomy. To date, needle arthroscopy allows a direct diagnosis of shoulder lesion. Few studies so far have demonstrated the potential use of nanoscopy in therapeutic processes as well.

Aim

We aimed to evaluate the technical feasibility of nanoscopy biceps isolated tenotomy by needle arthroscopy. The procedure was performed under local anesthesia, including suprascapular nerve block and additional eventual admission of benzodiazepines. The patient was discharged from the hospital after 4 hours after the surgery.

Material and methods

Patients over 70 years of age with LHBT lesions were qualified for the study. The patients mainly complained of symptoms characteristic of LHBT injuries. The lesion was confirmed in MRI. Prior to the surgery Constant Score, VAS and SSI score was assessed. To the study 10 patients were included. The follow-up period was at least 3 months.

Results

The patients presented prior to the surgery mean Constant score 43.2, VAS 8.2 and SSI 37.5. After surgery the results improved to Constant score 82.8, VAS to 1.9 and SSI to 82.3. The patients underwent the procedure without complications.

Conclusion

Advantages were found in the fast-track process and the high rate of satisfaction in our selected patients. Nanoscopy appears to be an excellent tool for patients with low functional demands, where the primary goal is pain management.

ARTHROSCOPIC ROTATOR CUFF REPAIR WITH TRANSOSSEOUS FIXATION. PRELIMINARY RESULTS, TECHNICAL TIPS AND TRICKS ON THE USE OF NOVEL TRANSOSSEOUS GUIDING DEVICE

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Introduction

Multiple techniques of rotator cuff repair are currently in use. Regardless the type, usually different implants are required to stabilise the repair. However, historically implantless transosseous repairs has proved its safety, reproducibility and results that are stable over time. Currently, there is a new dawn for arthroscopic devices allowing for the use transosseous repair technique, gaining attention from orthopaedic community.

Aim

The aim of this report is to give a short a description of novel device Drillbone Tunneler designed for arthroscopic transosseous rotator cuff repair. Authors present surgical steps, technical tips and tricks alongside short description of case series.

Material and methods

Case series of 12 patients (10 arthroscopic, 2 open) that were subjected to transosseous rotator cuff repair from 06.2024 to 12.2024 with the use of new device Drillbone Tunneler.

Results

All patients underwent surgical treatment, with no hardware - side complications. No neurological or vascular injury were observed. Surgical time did not differ significantly from "standard" rotator cuff repair. The use of transosseous fixation led to limited implant use.

Conclusion

A renewed interest in transosseous repair is justified by surgical simplicity, safety profile, cost-effectiveness and reproducibility of the new hardware in the field of shoulder surgery.

ASEPTIC INFLAMMATION OF THE CLAVICLE

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Introduction

Chronic recurrent multifocal osteomyelitis (CRMO) is a rare, autoinflammatory bone disorder that typically affects pediatric patients. It is characterized by relapsing pain, swelling, and inflammation in multiple skeletal sites or involving a single bone. The exact cause of CRMO remains unclear, and its management is not standardized.

Aim

The aim of this study is to present a 14-year-old female with chronic post-traumatic clavicle pain, who underwent surgery, received antibiotic treatment, and is currently undergoing Pamidronate therapy for persistent symptoms.

Material and methods

Our case involves a patient with persistent chronic pain in the right clavicle following a contusion. On examination, there was widening of the right clavicle's outline, a 10 degrees limitation of flexion and abduction, internal and external rotation of the shoulder were possible without restriction. The elbow, wrist, and hand demonstrated a full range of motion without pain. The limb exhibited normal blood supply and innervation. Initial biopsy of the clavicle revealed chronic inflammation. The patient underwent surgery involving part of the clavicle resection and inflammatory lesions removal. Further antibiotic treatment for persisting symptoms was unsuccessful. Given the ongoing symptoms and a family history of osteochondromas, we started pamidronate therapy.

Results

The patient reported significant improvement in symptoms following pamidronate therapy. After the first cycle, pain symptoms recurred only three times during three months.

Conclusion

This case highlights pamidronate's potential in managing CRMO in pediatric patients, significantly reducing pain severity and recurrence. It also underscores the diagnostic challenges posed by confounding factors, such as a history of trauma, which can obscure the clinical picture.

ANALYSIS OF THE RESULTS OF SURGICAL TREATMENT OF PATIENTS WITH SHOULDER JOINT INSTABILITY TREATED WITH THE LATARJET METHOD (OPEN TECHNIQUE) AND TRANSPLANTATION OF AN AUTOLOGOUS BONE BLOCK FROM THE ILIAC CREST (ARTHROSCOPIC TECHNIQUE) USING A SINGLE OSTEOCONNECT SMITHS & NEPHIEW ENDOBUTTON

Rafał Namyślak, Maciej Kuśnierkiewicz, Wojciech Marek
Klinika Silesia Opole

Introduction

Shoulder instability treatment sometimes includes filling the bone defect of the scapular glenoid.

Aim

The purpose of the study is to analyze the results of treatment of patients with shoulder joint instability treated with the Latarjet method and autologous bone block transplantation with a single Osteoconnect S&N endobutton.

Material and methods

The study included 8 patients with the bone-block and 10 with the Latarjet technique. The indication for the use of the bone graft technique was a glenoid defect of > 15%. Clinical results analyzed taking into account ROM, pain (VAS scale) and functional scales: SST, Constant Score and Walch Duplay – before the and one year after the procedure. Radiological examinations included MRI/CT before, X-ray 6 weeks after and CT 12 months after the procedure.

Results

In all patients clinical stability of the shoulder was achieved. In one-year observations, pain persisted longer in the Latarjet group. The limitation of ROM, 12 months after the procedure, concerned abduction and external rotation, greater in the group treated with the Latarjet method, but was not greater than 10° compared to the range before the procedure. In both groups, there was an improvement in the results according to the Simple Shoulder Test, Constant Score and Walch Duplay for Instability the Shoulder scales. We observed two radiological failures (incomplete union in the BB and implant destabilization in the Latarjet group).

Conclusion

The obtained results allow us to positively evaluate the stabilization method with a single Osteoconnect S & N endobutton. We plan to continue our study with additional comparative assessment of progressive arthritic changes in both techniques.

DETERMINING THE RECOVERY PACE AFTER ARTHROSCOPIC ROTATOR CUFF REPAIR

Maciej Pawlak

Rehasport Clinic

Introduction

Rotator cuff tears are a widespread medical problem and cause an important rate of morbidity and inability in workplace and sport activities. Arthroscopic rotator cuff repair is a gold standard in treatment of this pathology, but rehabilitation and recovery post operation is said to be hard and slow.

Aim

To determine recovery timing of patients who undergone rotator cuff repair.

Material and methods

A prospectively maintained institutional database was retrospectively reviewed for consecutive patients who underwent rotator cuff repair (RCR). Analysis of the following parameters was performed: UCLA score (3 questions and global score), SST (12 questions), Constant Score (10 questions and global score), ASES (12 questions and global score), ROM (flexion, abduction, and external rotation), strength assessed with BIODEX system. The analysis was performed for all patients together (1 group) at 3 months follow-up, 6 months follow-up, and 12 months follow-up.

Results

Range of motion was assessed and statistical significance was calculated between particular shoulder scores: 3 months vs 6 months, 3 months vs 12 months, 6 months vs 12 months.

Conclusion

Majority of patients regain full ROM after 12 months post operation and are satisfied with a treatment already after 3 months post operation.

PATHOLOGICAL HUMERAL FRACTURE IN A PEDIATRIC ATHLETE TRIGGERED BY THROWING A BALL

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Introduction

Among fractures in pediatric patients, humeral fractures are the most frequent. They are typically associated with direct external trauma. However, non-accidental trauma and pathological lesions should not be overlooked.

Aim

The aim of this study is to highlight the statistically rare non-neoplastic, serous fluid-filled bone lesion known as a unicameral bone cyst.

Material and methods

To describe the case, we utilized data from our hospital's system. We analyzed database entries, imaging studies, and histological examinations. Then we reported available literature.

Results

A 14-year-old male amateur athlete presented to our hospital with a preliminary diagnosis of a pathological right humeral fracture after throwing a water ball during training. Imaging studies revealed a spiral fracture of the distal shaft of the right humerus with bone fragments. Additionally, there was thinning of the cortical bone at the site of the fracture, as well as a change in the proximal two-thirds of the humeral shaft with heterogeneous contrast enhancement, which was suspected to be fibrous dysplasia. The patient underwent surgery with closed reduction and stabilization using TEN rods. Three months later, the patient required reoperation due to hardware irritation. Finally, after oncological consultation, the patient underwent an excision of the bone cyst, with the defect being filled using an allograft bone. Histopathological examination confirmed a cavernous hemangioma of the bone.

Conclusion

Simple bone cyst is a rare pathology. However, the orthopedic surgeon should keep it in mind to enable early and accurate diagnosis as well as appropriate treatment.

A FEASIBILITY STUDY COMPARING NANOSCOPY AND CONVENTIONAL ARTHROSCOPY FOR VISUALIZING SPECIFIC ANATOMICAL STRUCTURES OF THE KNEE JOINT IN HUMAN CADAVERS

Jędrzej Lesman, Błażej Wójtowicz, Marcin Domżański
Uniwersytet Medyczny w Łodzi

Introduction

In shoulder arthroscopy, a wide variety of endoscopes are currently available. However, 30° optics have become the standard for the procedure. The nanoscope has occasionally been used as a diagnostic tool. To date, no study has compared the performance of the nanoscope versus the standard arthroscope in terms of anatomical landmark visibility.

Aim

This prospective feasibility study aimed to evaluate predefined anatomical landmarks of the knee joint using a nanoscope with 0° optics and conventional knee arthroscopy with 30° optics, comparing their effectiveness during shoulder arthroscopy in human cadavers.

Material and methods

Examinations were performed on ten cadavers by two surgeons. The focus was on anatomical landmarks visible during conventional diagnostic shoulder arthroscopy. The quality of visibility was assessed using a questionnaire with a grading scale of 1 to 5.

Results

The average visibility score for all anatomical landmarks was 4.62/5 for arthroscopy and 4.42/5 for the nanoscope. Comparatively, the nanoscope demonstrated slightly reduced visibility for the posterior recess (4.46/5 vs. 4.1/5) and the bare area (4.38/5 vs. 4.17/5). However, the nanoscope slightly outperformed in visualizing the subacromial space (4.68/5 vs. 4.53/5).

Conclusion

The nanoscope offers significant potential as a technology, providing advantages such as minimally invasive access and clear visualization of anatomical structures. However, it does have limitations, particularly when navigating complex anatomical configurations or requiring a wide field of view.

ASSESSMENT OF ELBOW PROPRICEPTION WITH INERTIAL MEASUREMENT UNITS- VALIDITY AND RELIABILITY STUDY

Szymon Stupnicki, Grzegorz Mulski, Łukasz Żytka, Jakub Kaszyński, Cezary Baka, Bartłomiej Lubiatowski, Przemysław Lubiatowski
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Introduction

Proprioception is a key sensory function enabling individuals to perceive body position and movement. It is essential for optimal performance, particularly in athletes. However, accurately measuring proprioception remains a challenging task with the methods currently available.

Aim

This study assessed the reliability of elbow proprioception measurement using inertial motion sensors- IMU and validating IMU against other angle measurements methods.

Material and methods

Twenty healthy participants underwent active and passive proprioception assessments based on elbow joint position sense (JPS). Analyzed data was error of reproduction of joint position (ERJP). Angular measurements were performed using a single IMU (RSQ MOTION) and validated against BIODEX SYSTEM 4 moving frame.

Results

Inter-rater reliability for passive proprioception was high, with a Kendall's coefficient of 0.77 ($p < 0.05$) for both RSQ Motion sensors and BIODEX, while active proprioception measured with RSQ Motion sensors showed slightly lower reliability (Kendall's coefficient of 0.66, $p < 0.05$). Intra-rater reliability had similar results, with Kendall's coefficients of 0.74 for passive BIODEX proprioception examination, 0.75 for passive RSQ Motion sensor testing and 0.65 for active proprioception ($p < 0.05$) measured with RSQ Motion sensors. Bland-Altman analysis revealed that differences between the RSQ sensors and BIODEX were within the limits of agreement (LoA). Mean absolute value of the ERJP between RSQ sensors and BIODEX was 0.88° (95% CI: 0.79–0.98; SD: 0.71).

Conclusion

These results suggest that elbow joint position sense assessment methodology using IMU is reliable and accurate. The study serves as a background for further research of joint proprioception in the human body.

MODERN TECHNOLOGY APPLICATION IN UPPER LIMB REHABILITATION PROCESS

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Introduction

Modern technologies are more often used as an integral part of rehabilitation procedures. Different type of exercises and therapy in form of games and tasks are interesting activities especially among young patients. It allows to increase patients range of motion and to stimulate proprioception and muscles activation during different tasks. The innovative systems give also an opportunity to work with patients' cognitive abilities.

Aim

The aim of the study was to assess modern technology use in instability rehabilitation program.

Material and methods

23 patients due to their upper limb issues were included into the study (16F, 7M, age: 15–44). All participants underwent clinical diagnosis and upper limb assessment with isometric strength examination and stability examination. Each of participants received individual program of upper limb rehabilitation adjusted to their symptoms and complains. In the study we used 3 devices which were constructed by Technomex® – Capri, X-Cogni, and Leap Motion. Games were concentrating on wrist exercises consisting movements of palmar and dorsal flexion, ulnar and radial deviation and DTM plane exercises. All patients were collecting every time points for each session which were compared to assess the effectiveness of rehabilitation process.

Results

76% of participants assessed the modern technologies as interesting type of rehabilitation procedure with satisfaction rate 60–77%. There was no significant increase of patients shoulder isometric strength or global grip strength. Patients reported increase (30–45%) in muscle control and subjective proprioception improvement.

Conclusion

Modern technologies application may be an attractive type of rehabilitation process and allow to increase patient's involvement and therapy effectiveness.

PROFESSIONAL CLASSIC WRESTLING ATHLETES – BIOMECHANICAL EVALUATION OF ROTATOR CUFF PARAMETERS

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Introduction

Classic wrestling is a dynamic sport in which it is necessary to overpower the rival in order to move on to the techniques and actions for which points are scored. In this aspect it is necessary to have great grip strength and stability of the shoulder girdle thanks to which the athletes gain an advantage over their opponents.

Aim

The purpose of this study is to assess the specific grip strength of classical wrestling, the strength of the rotator muscles of the upper limb, and to determine the biomechanical profile of the athletes.

Material and methods

The study included 30 male classical wrestling athletes with national/international performance in the 6 months prior to the study with no history of a currently diagnosed injury. The Biodex System 4 Pro was used to measure isokinetic strength rotator muscles. A hand dynamometer was used to assess grip strength.

Results

There was significant difference ($p < 0.05$) between rotator cuff muscles biomechanical parameters. The average PQ/BW value at an angular velocity of $60^\circ/s$ for external rotation was 43.5 for the dominant upper limb and 43.7 for the non-dominant upper limb, internal rotation was 78.2 for the dominant upper limb and 75.1, for the non-dominant upper limb. The average grip strength was 51 for the right hand and 49.3 for the left hand.

Conclusion

Classical wrestling athletes are characterized by high grip strength, external and internal rotators of the arm regardless of lateralization. Due to the sports characteristic the internal rotators biomechanical parameters are significantly increased.

PROFESSIONAL WRESTLING ATHLETES- BIOMECHANICAL EVALUATION OF ELBOW STRENGTH: CROSS-SECTIONAL STUDY

Marcin Rybnik, Kornel Pękala, Marcin Redman, Marta Jokieli

Clinical Physiotherapy Students Scientific Group Poznan University of Medical Sciences

Introduction

Wrestling is a martial art and combat sport that involves grappling with an opponent and striving to obtain a position of advantage through different throws or techniques, within a given ruleset. This study attempts to analyze the Greco-Roman wrestling athletes.

Aim

The aim of this study was to compare the elbow biomechanical profiles of Greco-Roman wrestling athletes using muscle strength, endurance and the agonist/antagonist ratio as outcome measures.

Material and methods

A cross-sectional study was conducted on 33 male Greco-Roman wrestling athletes (ages 16–30) who competed at least at the national championship level. Upper extremity isokinetic strength was assessed using the Biodex System 4 Pro®. An isokinetic dynamometer was used to evaluate elbow flexion and extension.

Results

There was no significant difference ($p > 0.05$) in average peak torque relative to body weight, total work and agonist/antagonist ratio between the dominant and non-dominant limb during elbow flexion and extension. The average peak torque/body weight during extension was 73.7 NM in dominant and 72.9 NM in non-dominant extremity and 63.3NM in dominant and 63.4 NM in non-dominant extremity during flexion. The average total work was 744.9NM in dominant and 752.3 NM in non-dominant in extension and 903.1NM in dominant and 880.7 NM in non-dominant extremity in flexion. The average agonist/antagonist ratio was 86.2% in dominant and 86.4% in non-dominant extremity.

Conclusion

Consequently, optimal muscle strength and endurance in both limbs are essential for athletic wrestling performance and may play a key role in the overall neuromuscular development of wrestlers.

VALIDATION AND RELIABILITY OF SCAPULAR MORPHOLOGY ASSESSMENT USING MIXED REALITY

Szymon Stupnicki, Mikołaj Zakryś, Bartosz Gołembiewski, Stanisław Komisarczyk, Jan Klincewicz, Anna Maria Kubicka, Bartłomiej Lubiowski, Przemysław Lubiowski
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Introduction

Recent advancements in Augmented (AR) and Mixed Reality (MR) have significantly impacted the orthopedic field, with hope of holographic tools to enhance surgical precision. This study validates and explores the reliability of a specially designed software tool, integrated with HoloLens2 for measuring anatomical structures of the shoulder girdle in orthopedic surgery.

Aim

The purpose of this study was to validate and investigate the reliability of RSQ Holo software as a measurement tool integrated with Microsoft HoloLens 2 device.

Material and methods

Fifty-one right human scapulas obtained from the Department of Zoology at Poznan University of Life Sciences were measured directly using a caliper, on 2D and 3D CT scans and with holographic instruments (RSQ Holo system). Glenoid height, glenoid width and scapular width were measured. Imaging methods were validated against direct caliper measurements. Intra-rater and inter-rater reliability was assessed among four testers.

Results

Descriptive statistics indicated minimal measurement differences across all groups, with the majority of differences being under 1 mm. Comparison graphs, and descriptive statistics showed that in glenoid height and glenoid width RSQ Holo measurements are the closest to direct measurements. Scapula width measurements done with every technique were equal. ICC revealed excellent intra-rater reliability for scapula width (0.96) and glenoid width (0.91), and good reliability for glenoid height (0.85). Inter-rater reliability also showed promising results, particularly for scapular width (0.91) and glenoid width (0.78), although glenoid height (0.72) showed moderate agreement.

Conclusion

Findings demonstrate that RSQ Holo software provides accurate and consistent measurements, supporting its potential use in preoperative planning and intraoperative navigation.

ARTHROSCOPIC LATARJET-BANKART PROCEDURE FOR RECURRENT ANTERIOR DISLOCATION OF THE SHOULDER: PROSPECTIVE AND RETROSPECTIVE STUDY WITH 5 YEAR FOLLOW-UP

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Introduction

The Latarjet-Bankart procedure is one of the most effective techniques for the treatment of recurrent anterior instability of the shoulder joint. Indications for this type of surgery are not homogeneous but the most important is bone loss of the glenoid. The procedure is based on transferring the coracoid process to the anterior rim of the glenoid. The arthroscopic technique is much more demanding than the open technique and its long-term results are still poorly studied.

Aim

The aim of the study was to clinically and biomechanically assess the condition of the shoulder joint of patients at least five years after the arthroscopic Latarjet procedure.

Material and methods

We conducted the prospective and retrospective assessment of 10 patients (1 women) at least 5 years after the Latarjet procedure. The evaluation included biomechanical testing and clinical assessment using shoulder scores (UCLA, ASES, SST, WOSI). Additionally, the presence of degenerative changes was investigated after 5 years based on X-ray imaging.

Results

No patient developed a recurrence of shoulder dislocation during the follow-up period, but one patient had a positive apprehension test. 3 patients had slight degenerative changes on X-ray (I in Samilson-Prieto scale). Biomechanical testing showed no external rotation deficit. The range of external rotation was minimally reduced (7.7 +/- 7.5 degrees). UCLA scale was almost perfect (32.2 +/- 3.5 points) as well as the other scales.

Conclusion

Patients 5 years after arthroscopic Latarjet have very good shoulder function without significant restrictions. Degenerative changes are relatively few and of low intensity.

ASEPTIC INFLAMMATION OF THE CLAVICLE

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Introduction

Chronic recurrent multifocal osteomyelitis (CRMO) is a rare, autoinflammatory bone disorder that typically affects pediatric patients. It is characterized by relapsing pain, swelling, and inflammation in multiple skeletal sites or involving a single bone. The exact cause of CRMO remains unclear, and its management is not standardized.

Aim

The aim of this study is to present a 14-year-old female with chronic post-traumatic clavicle pain, who underwent surgery, received antibiotic treatment, and is currently undergoing Pamidronate therapy for persistent symptoms.

Material and methods

Our case involves a patient with persistent chronic pain in the right clavicle following a contusion. On examination, there was widening of the right clavicle's outline, a 10 degrees limitation of flexion and abduction, internal and external rotation of the shoulder were possible without restriction. The elbow, wrist, and hand demonstrated a full range of motion without pain. The limb exhibited normal blood supply and innervation. Initial biopsy of the clavicle revealed chronic inflammation. The patient underwent surgery involving part of the clavicle resection and inflammatory lesions removal. Further antibiotic treatment for persisting symptoms was unsuccessful. Given the ongoing symptoms and a family history of osteochondromas, we started pamidronate therapy.

Results

The patient reported significant improvement in symptoms following pamidronate therapy. After the first cycle, pain symptoms recurred only three times during three months.

Conclusion

This case highlights pamidronate's potential in managing CRMO in pediatric patients, significantly reducing pain severity and recurrence. It also underscores the diagnostic challenges posed by confounding factors, such as a history of trauma, which can obscure the clinical picture.

ARTHRODESIS IN TREATMENT OF SHOULDER INSTABILITY IN A PEDIATRIC PATIENT

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Karola Marcinkowskiego w Poznaniu

Introduction

Hypermobility, as an increase in the range of motion within a joint, occurs in the course of diseases with connective tissue disorders. Susceptibility to injury can result in joint instability, including recurrent dislocations and pain. In cases of severe hypermobility, where traditional rehabilitation methods prove ineffective, surgical interventions are considered.

Aim

This case report presents the results of surgical treatment of the right shoulder instability in a 9-year-old female with hypermobility and habitual dislocations of this joint in the course of Ehlers-Danlos syndrome.

Material and methods

A 9-year-old female wheelchair user with hypermobility due to Ehlers-Danlos syndrome, experiencing significant right shoulder instability and right brachial plexus birth palsy. Instability caused habitual dislocation of the right shoulder since birth with a high pain component, preventing effective rehabilitation. After establishing the indications, shoulder arthrodesis was performed, including stabilization with Kirschner wires and supplementation with bone grafts. Nine months post-surgery, range of motion, pain, and radiological evaluation were conducted.

Results

The arthrodesis resulted in the stabilization of the shoulder. Nine months after the procedure, no passive motion and a significant reduction in shoulder pain were observed. Diagnostic imaging did not provide sufficient evidence to confirm permanent bone fusion in the joint.

Conclusion

Arthrodesis achieved very good outcomes in this patient. Despite restricting the joint's mobility, the procedure significantly improved the patient's condition and enhanced the quality of her life.

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W przypadku produktów stosowanych w eksperymentach lub metod (szczególnie te określone przez nazwę handlową), należy podać pełną nazwę producenta oraz lokalizację (w nawiasach). Jeśli to możliwe, używać nazw rodzajowych leków.

Strona tytułowa

Pierwszej stronie maszynopisu powinna zawierać tytuł artykułu, pełne imiona i nazwiska autorów bez stopni i tytułów, afiliacje autorów z miastem i krajem oraz tytuł skrócony nieprzekraczający 40 liter wraz ze spacjami. Pierwsza strona powinna również zawierać dane autora do korespondencji: pełny adres pocztowy, adres e-mail oraz numery telefonu i faksu.

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Streszczenie nie powinno przekraczać 250 słów i powinno być podzielone na oddzielne sekcje: Wprowadzenie, Cel, Materiał i metody, Wyniki i Wnioski. Powinno być zwięzłe oraz wskazywać znaczące wyniki. Streszczenie powinno zawierać od 3 do 6 słów kluczowych. Powinny one odzwierciedlać główny temat artykułu (unikać słów wykorzystanych już w tytule).

The following categories of articles can be proposed to Issue of Rehabilitation, Orthopaedics, Neurophysiology and Sport Promotion – IRONS:

Original papers

Manuscripts in this category describe the original results from the field of rehabilitation, physiotherapy, orthopaedics, and neurophysiology as well as topics dealing with diagnostic and treatment of sport-related traumas. The manuscript should be presented in the format of Summary (250-word limit) and Main text (Title page, Summary, Introduction, Aim, Material and Methods, Results, Discussion, Conclusions, Acknowledgments, Conflict of Interest, References, and Figure Legends). In the Discussion section, statements regarding the importance and novelty of the study should be presented. In addition, the limitations of the study should be articulated. The abstract must be structured and include Introduction, Aim, Material and Methods, Results, and Conclusions. Manuscripts cannot exceed 2700–3000 words in length (excluding title page, abstract, and references) and contain no more than a combination of 8 tables and/or figures. The number of references should not exceed 45. This type of article should include statistical procedures.

Research reports

Manuscripts in this category may present results of studies involving small sample sizes, introduce new methodologies, describe preliminary findings or replication studies. The manuscript must follow the same format requirements as full-length manuscripts. Brief reports should be not less than 2000 words (excluding title page, abstract, and references) and can include up to 3 tables and/or figures. The number of references should not exceed 25. This type of article should include statistical procedures.

Następujące kategorie artykułów mogą zostać zaproponowane do wydawania w Zeszytach Promocji Rehabilitacji, Ortopedii, Neurofizjologii i Sportu – IRONS:

Oryginalny artykuł naukowy

Manuskrypt w tej kategorii opisuje wyniki badań przeprowadzonych w oryginalnym, szerokim obszarze powiązanych z rehabilitacją, fizjoterapią, ortopedią i neurofizjologią jak i dotyczące zagadnień związanych z diagnostyką i leczeniem urazów sportowych. Manuskrypt powinien być przedstawiony w formie streszczenia (limit 250 słów) i tekstu głównego (Strona tytułowa, Streszczenie, Wprowadzenie, Cel, Materiał i metody, Wyniki, Dyskusja, Wnioski, Podziękowania, Konflikt interesów, Piśmiennictwo oraz Objaśnienia rycin). W sekcji Dyskusja należy zaprezentować stwierdzenia dotyczące znaczenia i nowości tych badań. Ponadto w pracy należy zawrzeć ograniczenia przeprowadzonych badań. Streszczenie musi być zrestrukturyzowane i zawierać: Wstęp, Cel, materiał i metody, wyniki i wnioski. Rękopis nie może przekroczyć długości 2700–3000 słów (bez strony tytułowej, streszczenia i piśmiennictwa) i zawierać nie więcej niż 8 tabel i / lub rycin. Ilość przypisów nie powinna przekraczać 45. Ten rodzaj artykułu powinien zawierać procedury statystyczne.

Raporty z badań

Manuskrypt w tej kategorii może przedstawiać wyniki badań z udziałem małej próby, przedstawienie nowych metod, należy opisać wstępne ustalenia lub badania replikacji. Manuskrypt musi mieć tę samą formę co pełnej długości manuskrypt. Raport z badań nie powinien zająć mniej niż 2000 słów (z wyłączeniem strony tytułowej, streszczenia oraz piśmiennictwa) i może zawierać do 3 tabel i / lub rycin. Ilość przypisów nie powinna przekraczać 25. Ten rodzaj artykułu powinien zawierać procedury statystyczne.

Case studies

This guide examines case studies, a form of qualitative descriptive research that is used to look at individuals, a small group of participants, or a group as a whole. Researchers collect data about participants using participant and direct observations, interviews, protocols, tests, examinations of records, and collections of writing samples. Starting with a definition of the case study, the guide moves to a brief history of this research method. Using several well-documented case studies, the guide then looks at applications and methods, including data collection and analysis. A discussion of ways to handle validity, reliability, and generalizability follows, with special attention to case studies as they are applied to composition studies. Finally, this guide examines the strengths and weaknesses of case studies. The manuscript must follow the same format requirements as full-length manuscripts. Case Studies should be up to 2700 words (excluding title page, abstract, and references) and can include up to 3 tables and/or figures. The number of references should not exceed 25.

Review papers

These articles should describe recent advances in areas within the Journal's scope. Review articles cannot exceed 2700–3000 words in length (excluding title page, abstract, and references) and contain no more than a combination of 10 tables and/or figures. Authors are encouraged to restrict figures and tables to essential data that cannot be described in the text. The number of references should not exceed 60.

Guidelines

Guidelines should be up to 2000 words (excluding title page, abstract, and references) and can include up to 3 tables and/or figures. The number of references should not exceed 25.

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Artykuł ten analizuje studium przypadku, forma jakościowych badań opisowych, który jest używany, aby przeanalizować pojedyncze przypadki, małe grupy uczestników, lub grupy, jako całości. Naukowcy zbierają dane dotyczące uczestników badania i bezpośrednich obserwacji, wywiadów, protokołów testów oraz egzaminów. Manuskrypt musi spełniać te same wymogi formatu jak pełnej długości rękopis. Studium przypadku powinno zawierać do 2700 słów (z wyłączeniem strony tytułowej, streszczenia oraz piśmiennictwa) i może zawierać do 3 tabel i / lub rycin. Liczba piśmiennictwa nie powinna przekraczać 25.

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Artykuł ten powinien opisywać najnowsze postępy w dziedzinach należących do zakresu czasopisma. Artykuł przeglądowy nie może przekraczać 2700–3000 słów (z wyłączeniem strony tytułowej, streszczenia i piśmiennictwa) i zawierać nie więcej niż 10 tabel i / lub rycin. Autorzy są zachęceni do ograniczenia ilości tabel i rycin do podstawowych danych, które nie mogą być opisane w tekście. Liczba piśmiennictwa nie powinna przekraczać 60.

Wytyczne/Zalecenia

Wytyczne powinny być do 2000 słów (z wyłączeniem strona tytułowa, streszczenie oraz referencje) i może zawierać do 3 stoły i / lub cyfr. Liczba odniesień nie powinna przekraczać 25.

Acknowledgments

Under acknowledgments please specify contributors to the article other than the authors accredited. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proofreading the article, etc.). Also, acknowledge all sources of support (grants from government agencies, private foundations, etc.). The names of funding organizations should be written in full.

References

All manuscripts should use the 'Harvard' style for References.

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Example:

Elhassan, B., Bishop, A., Shin, A., Spinner, R. (2010) 'Shoulder tendon transfer options for adult patients with brachial plexus injury.' *J Hand Surg Am.*, 35 (7), pp. 1211–1219.

Article from a journal:

Elhassan, B., Bishop, A., Shin, A., Spinner, R. (2010), 'Shoulder tendon transfer options for adult patients with brachial plexus injury.' *J Hand Surg Am.*, 35 (7), pp. 1211–1219.

Książki:

Rang, H. P., Dale, M. M., Ritter, J. M., Moore, P. K. *Pharmacology*. 5th Ed. Edinburgh: Churchill Livingstone, 2003.

Phillips, S.J., Whisnant, J.P. *Hypertension and stroke*. In: Laragh JH, Brenner BM, Editors. *Hypertension: pathophysiology, diagnosis, and management*. 2nd Ed. New York: Raven Press; 1995. pp. 465–478.

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Przykład:

Elhassan, B., Bishop, A., Shin, A., Spinner, R. (2010), 'Shoulder tendon transfer options for adult patients with brachial plexus injury.' *J Hand Surg Am.*, 35 (7), pp. 1211–1219.

Artykuł z czasopisma:

Elhassan, B., Bishop, A., Shin, A., Spinner, R. (2010), 'Shoulder tendon transfer options for adult patients with brachial plexus injury.' *J Hand Surg Am.*, 35 (7), pp. 1211–1219.

Książki:

Rang, H. P., Dale, M. M., Ritter, J. M., Moore, P. K. *Pharmacology*. 5th Ed. Edinburgh: Churchill Livingstone, 2003.

Phillips, S.J., Whisnant, J.P. *Hypertension and stroke*. In: Laragh JH, Brenner BM, Editors. *Hypertension: pathophysiology, diagnosis, and management*. 2nd Ed. New York: Raven Press; 1995. pp. 465–478.

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