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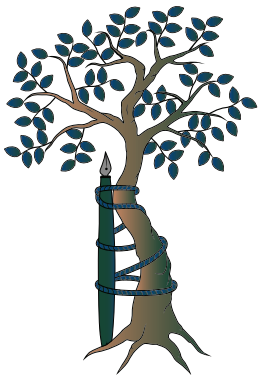

The Philippine Journal of Orthopaedics

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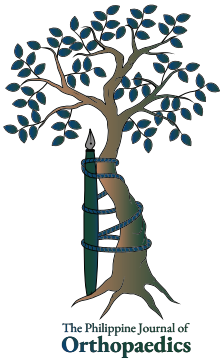
ORIGINAL ARTICLES

CASE REPORTS



ABOUT THE LOGO: THE TREE OF ANDRY

Nicholas Andry coined the French term “orthopédie” which is derived from the Greek words “orthos” (correct or straight) and “paidion” (child). As implied in its etymology, “orthopédie” was first practiced treating childhood spinal and bone deformities.

The main elements of the logo are the tree of Andry; the Philippine Journal of Orthopaedics wordmark; and the fountain pen. The fountain pen, in replacement of the stake, represents how research has been the backbone of orthopaedic learning and practice.

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The **Philippine Journal of Orthopaedics,** the official journal of the **Philippine Orthopaedic Association, Inc.** is an open-access, English language, web-based, medical science journal published by the Association. The Journal is guided by the International Committee of Medical Journal Editors (ICMJE) **"Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals."**

The **Philippine Journal of Orthopaedics** shall advance the art and science of orthopaedics in the country by publishing high quality original clinical investigations, epidemiological studies, case reports, review articles, evaluations of diagnostic and surgical techniques, and the latest updates on management guidelines. The journal's target audience are local and international practitioners, clinicians, and other scientists, researchers. It shall accept manuscript submissions from consultants, fellows, residents, and other allied medical professions and specialties, not only from the Philippines but also from Asia and the rest of the world as long as these are within scope and relevant to the practice. Non-members of the Association may submit scientific manuscripts to the journal.

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EDITORIAL TEAM

Address: Doctors' Offices, Mezzanine Floor, Philippine Orthopedic Center,
75 Maria Clara St., Brgy. Lourdes, Quezon City 1114, Philippines
E-mail: editorialteam@philjorthopaedics.org | Website: https://philjorthopaedics.org

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On behalf of the Editorial Board of the Philippine Journal of Orthopedics and the Board of Trustees of the Philippine Orthopaedic Association, it is with pride that we present to you the second issue of the PJO for 2025, featuring original research articles and interesting case reports.

The articles represent the diverse interests and evolving landscape of orthopedic practice in the Philippines. Our original articles focus on infection, pain, and a Filipino validation study of a standard hip scoring system. We also feature interesting case studies that highlight our uniqueness.

Thank you to the authors and reviewers for your continued support and hard work. We hope that this issue inspires the fellows of the POA, our training residents, and readers to continue doing research that fulfills our mission of advancing orthopedic care in the Philippines.

Justinian Aquilino IV Cyril LI. Pimentel, MD, FPOA
President, Philippine Orthopaedic Association and ASEAN Orthopaedic Association

The Philippine Journal of Orthopaedics

It Takes Real Intelligence to Use Artificial Intelligence Intelligently

I recently came across an article in my favorite online news source, The New York Times, about the use of Artificial Intelligence (AI) in interviewing job applicants.[1] This got me wondering how else AI touches our lives. Alexa and Siri have created countless music playlists, organized appointments, arranged daily schedules, and activated numerous robot vacuums worldwide. We haven't even started on the use of AI in manufacturing these devices before they reach our households. AI's impact has been significant and ever-increasing the past two decades.

This brings me to the advent of ChatGPT (Chat Generative Pretrained Transformer) and its use in research. This Large Language Model (LLM) has made quite a splash since its launch in 2022, being used to generate resumes, reports, images, homework, and alas, research protocols and papers. Grammar and spelling checkers that used to elicit wonder some decades ago are now seen as rudimentary and archaic. Now, an entire "research" can be generated within seconds, complete with the occasional bogus references—note the recently retracted report from the health department of a certain North American nation. In response, the scientific community has scrambled to address the increasingly common use of this tool.

The World Association of Medical Editors (WAME) has issued guidelines on the use of AI in scientific papers,[2] the salient points being: 1. Chatbots cannot be authors; 2. Transparency about its use is demanded; 3. Authors are responsible for verifying content that is Chatbot-generated; and 4. Editors must be able to screen for AI-generated content. The Philippine Journal of Orthopaedics editorial board has adopted these guidelines (available on our website), and all submissions are now screened, not only for plagiarism but also for AI contribution. A transparency statement and a statement of responsibility on the use of AI are now required before submissions are processed and sent to review. These steps are an initial response to the widespread use of this technology and will evolve further as we, editors, scientists, researchers, and the discerning public acclimate to this new world of AI.

Before you assume that I am calling for the eradication of AI, allow me to clarify. AI, specifically LLMs, makes many tasks easier. These include writing, editing, translation, summarizing, generating ideas, and creating outlines, to name a few. It will continue to improve and expedite even more tasks. It will continue to grow in popularity, and the day will come when it will be taken for granted. This is a good thing, especially for scientists and researchers. Efficiency in one task frees up time that can be used for other tasks. This is something we will benefit from.

So, how should the scientific community react to the rise of the chatbots? As readers and consumers of scientific research, we need to ensure that what we read is real. This brings the role of "real intelligence" or human intervention to light. AI users need to verify the output of these programs to check to see if the information and references are indeed real. Users need to be transparent about the contributions of AI and accountable for their work.[3] This way, we can regard it as truly just a tool and not the maker. Artificial intelligence is a huge wave that is going to hit us no matter what—we can either scramble for an umbrella or put on our swimsuits. Now, where's my Speedo...

Tammy L. Dela Rosa, MD, MMedSc
Editor-in-Chief

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ORIGINAL ARTICLE

Efficacy of Hyaluronic Acid-capped Silver Nanoparticles Against the Top Five Clinical Bacterial Isolates from Open Fracture Wounds

Hansel Gould B. Cocjin, MD, FPOA,[1] Shaun A. Porras, MD, FPOA,[1] John Paolo J. Sanchez, MD, FPOA,[1] Rene P. Magalona, MD,[1] Ma. Ella Muriel F. Valdevieso, MD, DPBO,[1] Alain C. Juayang, RMT, PhD,[2] David S. Hinolan, MSc, RPh,[3] Hazel Joan T. Balomit, RN[4]

[1]*Department of Orthopaedics and Traumatology, Corazon Locsin Montelibano Memorial Regional Hospital, Bacolod City, Negros Occidental, Philippines*
[2]*Department of Pathology and Molecular Laboratory, Corazon Locsin Montelibano Memorial Regional Hospital, Bacolod City, Negros Occidental, Philippines*
[3]*Pharmacy Program, Colegio San Agustin-Bacolod, Bacolod City, Philippines*
[4]*HeaRTnovation Hub, Corazon Locsin Montelibano Memorial Regional Hospital, Bacolod City, Negros Occidental, Philippines*

ABSTRACT

Introduction. Orthopaedic infections from open fracture wounds remain a significant clinical problem. While the use of silver nanoparticles has become popular because of promising antibacterial properties, clinical application is limited due to unstable particle size during synthesis and storage. Hyaluronic acid, a sugar molecule used by the body for tissue repair, can potentially stabilize silver nanoparticles, but this capability has not yet been proven.

Methodology. The silver nanoparticle (AgNP) was synthesized through a redox reaction using hydrogen peroxide. The hyaluronic acid (HA) was used to modify the surface of the silver nanoparticles by acting as a capping agent. The antibacterial properties were tested against the top five clinical bacterial isolates from Orthopaedic wounds reported by the institution's Infection Control Committee using the MTT[3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide] Assay.

Results. The hyaluronic acid-capped (HA-AgNP) and uncapped (AgNP) silver nanoparticles exhibited antibacterial properties, and the capped silver nanoparticle exhibited stability. The HA-AgNP were observed to have dose-dependent antibacterial activity. Specifically, at 100 mcg/mL, HA-AgNP exterminated 60% of the clinical isolates including *S. aureus*, *P. aeruginosa*, *K. pneumonae*, *E. coli*, and MRSA with half-maximal inhibitory concentrations (IC50) of 42.11, 102, 58.5, 63.2 and 65.6 mcg/mL, respectively.

Conclusion. The synthesized HA-AgNP showed promising antibacterial activity against the top five clinical bacterial isolates from orthopaedic wound infections, and stable dose-dependent activity as compared to the uncapped AgNP.

Keywords. silver nanoparticles, hyaluronic acid capped silver nanoparticles, orthopaedic wound bacterial isolates, open fracture infections

INTRODUCTION

Orthopaedic infections remain a major health issue. Open fractures require antibiotics, adequate debridement, and appropriate stabilization.[1-4] Infection rates range from 0-2%, 2-10%, and 10-50%, for Gustilo Type 1, Type II, and Type III fractures, respectively.[5-9]

Emerging drug-resistant bacteria further exacerbate the problem, necessitating investigation and development of new antimicrobial agents, which can be costly. Silver-based antimicrobial agents and antiseptics have broad-spectrum antibacterial activity and are less likely to induce antimicrobial resistance.[10-13] In addition, silver ion-based agents were highly toxic to as many as 12 species of bacteria.[14] Their efficiency,

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Corresponding author: Hansel Gould B. Cocjin, MD, FPOA
Medical Specialist III, Department of Orthopaedics and Traumatology, Corazon Locsin Montelibano Memorial Regional Hospital, Lacson St., Bacolod City, Negros Occidental, 6100, Philippines
Tel. No.: (034) 703-1350
E-mail: hanselgouldcocjin@gmail.com
ORCiD: https://orcid.org/0000-0001-6010-431X

reliability, and biocompatibility are further enhanced when reduced in size to nanoparticles, and coated with amphiphilic hyperbranched macromolecules.[15,16] Silver-based antimicrobial compounds are continuously being evaluated but their use is limited because resistance and toxicity have not yet been extensively studied.[17]

One example is the wound healing agent silver-chitosan compound. The inclusion of silver nanoparticles (AgNPs) improved antimicrobial activity against drug-sensitive and drug-resistant microorganisms.[18,19] Another example is AgNP synthesized from Lansium domesticum fruit peel extract which was histocompatible and reduced time to wound closure.[20] In vitro toxicity studies show that AgNPs at 1.56–6.25 g/mL concentrations are safe for use.[21]

Commercially, silver-containing antimicrobial compounds, such as silver nitrate, silver sulphadiazine, silver sulphadiazine/chlorhexidine, silver sulphadiazine with cerium nitrate, and silver sulphadiazine impregnated lipid-colloid wound dressing are available. Innovations such as Acticoat™ and Silverlon ensure a controlled release of silver nanoparticles to the wound surfaces.[22] Use of these dressings for seven days resulted in bacterial death.[23] Wound dressings manufactured through green methods, such as bacterially-synthesized cellulose, have also been incorporated with AgNPs.[24]

The antimicrobial action of the silver nanoparticles is initiated upon contact with a peptidoglycan cell wall of the microorganism, penetration into the plasma membrane, and interaction with cytoplasmic DNA and proteins.[25] Ionic interaction with organic compounds can help explain the antibacterial properties. Clinical studies showed that AgNPs reduced bacterial colonization while producing lesser discomfort in the healing process.[26]

This study evaluated the use of hyaluronic acid as a coating mechanism for silver nanoparticles and the antibacterial efficacy of hyaluronic acid-capped silver nanoparticles against the top five clinical orthopaedic wound isolates based on the institution's antibiogram. The study intended to provide foundational evidence on the minimum inhibitory concentration of hyaluronic acid-capped silver nanoparticles.

METHODOLOGY

This experimental laboratory study was performed in Corazon Locsin Montelibano Memorial Regional Hospital, Bacolod City, in collaboration with the University of San Agustin, Bacolod City. The study was approved by the institution's PHREB accredited ethics review committee. The hyaluronic acid-capped silver nanoparticles (HA-AgNP) were synthesized at Colegio San Agustin-Bacolod's Pharmacy Laboratory. The top five clinical bacterial isolates from orthopaedic wounds were identified based on the hospital Infection Control Committee antibiogram annual reports for the previous five years. The bacterial isolates were retrieved from the Microbiology section of the Department of Pathology of Corazon Locsin Montelibano Memorial Regional Hospital. The ESKAPE isolates tested were *Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pneumoniae, Escherichia coli,* and Multidrug Resistant *Staphylococcus aureus (MRSA).* Antimicrobial properties were tested using the MTT[3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide] assay in three replicates in the institution's laboratory department.

Synthesis of Hyaluronic Acid-capped Silver Nanoparticles (HA-AgNP) and Non-capped Nanoparticles (AgNP)

The loading capacity of AgNP was calculated based on the elemental ratio of silver to carbon ratio where silver represented AgNPs and carbon represented HA. Theoretically, 1 mole of HA contained 7 moles of carbon, while 1 mole of AgNP contained 1 mole of silver.

The Hyaluronic Acid-capped Silver Nanoparticles (HA-AgNP) were synthesized with a few modifications (Figure 1).[27]

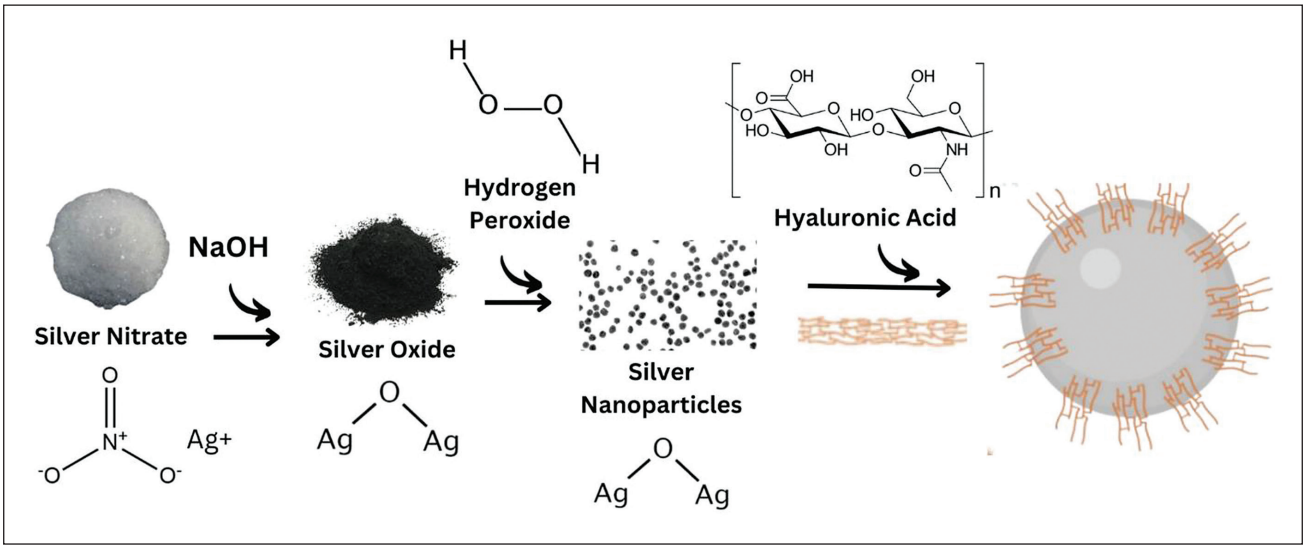

Figure 1. Synthesis of Hyaluronic Acid-capped Silver Nanoparticles (HA-AgNP).

- Hyaluronic acid (HA) and silver nitrate (AgN) solutions were each prepared into 5 mM solutions.
- In a beaker, 10 mL of silver nitrate was added. Sodium hydroxide (50 mcl, 1 M) was added dropwise while stirring at 25° C.
- On this solution, 10 mL of 30% hydrogen peroxide was added dropwise while stirring at 25° C.
- The solution was then stirred continuously for 1 hour in the dark.
- The gray solution was centrifuged at 1150 rpm at 8° C via ultracentrifugation and washed thrice with deionized water to obtain silver nanoparticles (AgNP).
- Then, 1.4 mg of freshly harvested AgNP was mixed with 100 PPM hyaluronic acid in 10 mL deionized water.
- The pH was then adjusted to 4, then the solution was stirred for 1 hour at 25° C in the dark to obtain hyaluronic acid (HA)-capped AgNP.
- HA-AgNP was then washed thrice with deionized water.

MTT assay

Bacterial isolates, with a density of 10^4 per well were seeded on a 96-well plate for 24 hours in Tryptic Soy (TS) broth (Figure 2).

- After 24 hours, the growth medium was pipetted out and the bacterial colonies were gently washed once with Phosphate Buffered Saline (PBS).
- The growth media containing varying concentrations of AgNP, HA-AgNP (100 mcg/mL, 50 mcg/mL, and 25 mcg/mL) and gentamicin (2.5 mg/mL) were seeded, and left for another 24 hours.
- After 24 hours, the growth media containing the AgNP, HA-AgNP and gentamicin was pipetted out, and gently washed thrice with PBS. Afterwards, MTT reagent diluted at a ratio of 1:9 was added.
- After 4 hours, the MTT reagent was pipetted out of the growth media, the crystals were dissolved in Dimethyl Sulfoxide (DMSO) (pH adjusted to 8 using Sodium Hydroxide) and their optical density was read by the microplate reader set at 590 nm.
- An online calculator was used to determine the Inhibition Concentration at 50% (IC50) of the material to each bacterium (https://www.aatbio.com/tools/ic50-calculator).
- The MTT assay was done in three replicates.

Statistical analysis

The percent viability for each dose of the material (AgNP vs. HA-AgNP) was analyzed using one-way ANOVA followed by Tukey's post-hoc test via an online software tool (https://astatsa.com/OneWay_Anova_with_TukeyHSD/). Statistical significance was determined based on these tests. In addition, the R^2 value was used to assess the correlation between dose and percent cell viability, indicating the antimicrobial effect. An R^2 value closer to 1 suggests a stronger correlation, with values above 0.8 generally considered indicative of a strong positive correlation.

RESULTS

The antibacterial efficacy of hyaluronic acid-capped silver nanoparticles (HA-AgNPs) was compared to uncapped silver nanoparticles (AgNPs) against five clinical ESKAPE pathogens: *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Escherichia coli*, and methicillin-resistant *S. aureus* (MRSA). As shown in Figures 3 and 4, both nanoparticle types exhibited concentration-dependent antibacterial activity, with increasing doses (25, 50, and 100 μg/mL) resulting in decreased bacterial cell viability. Notably, HA-AgNPs consistently demonstrated enhanced bactericidal effects compared to uncapped AgNPs across all tested isolates. This enhancement was particularly evident at lower concentrations. For instance, HA-AgNPs at 50 μg/mL frequently outperformed AgNPs at 100 μg/mL. Among the pathogens tested, *K. pneumoniae*, *E. coli*, and MRSA exhibited the highest susceptibility to HA-AgNPs, with bacterial cell viability significantly reduced relative to both AgNP-treated and gentamicin-treated controls (p <0.05). Furthermore, higher R^2 values in the HA-AgNP-treated groups indicate

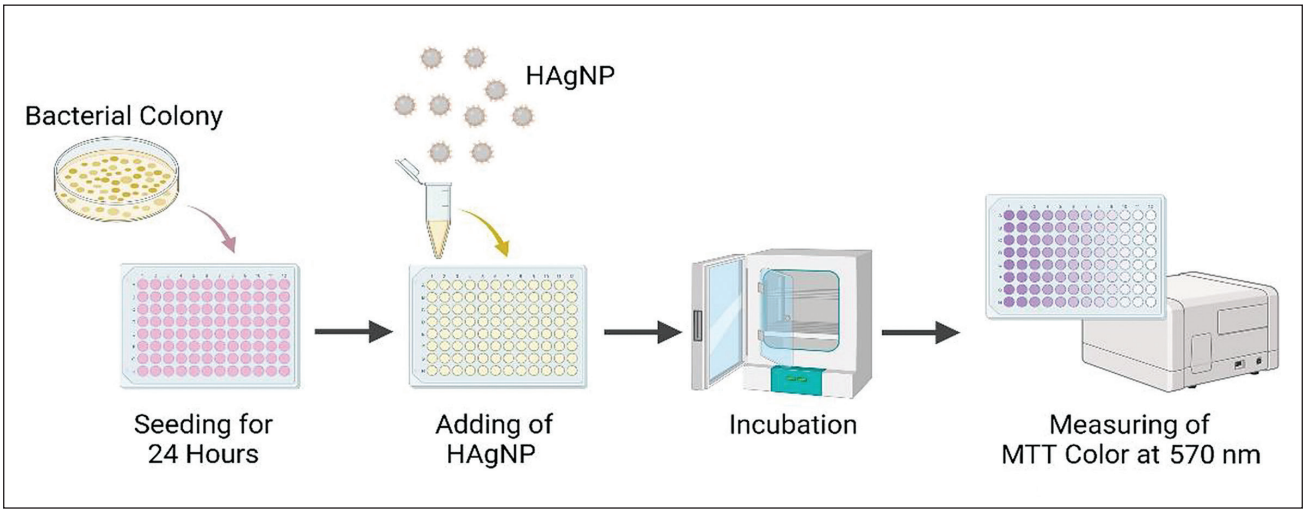

Figure 2. MTT Assay of HA-AgNP.

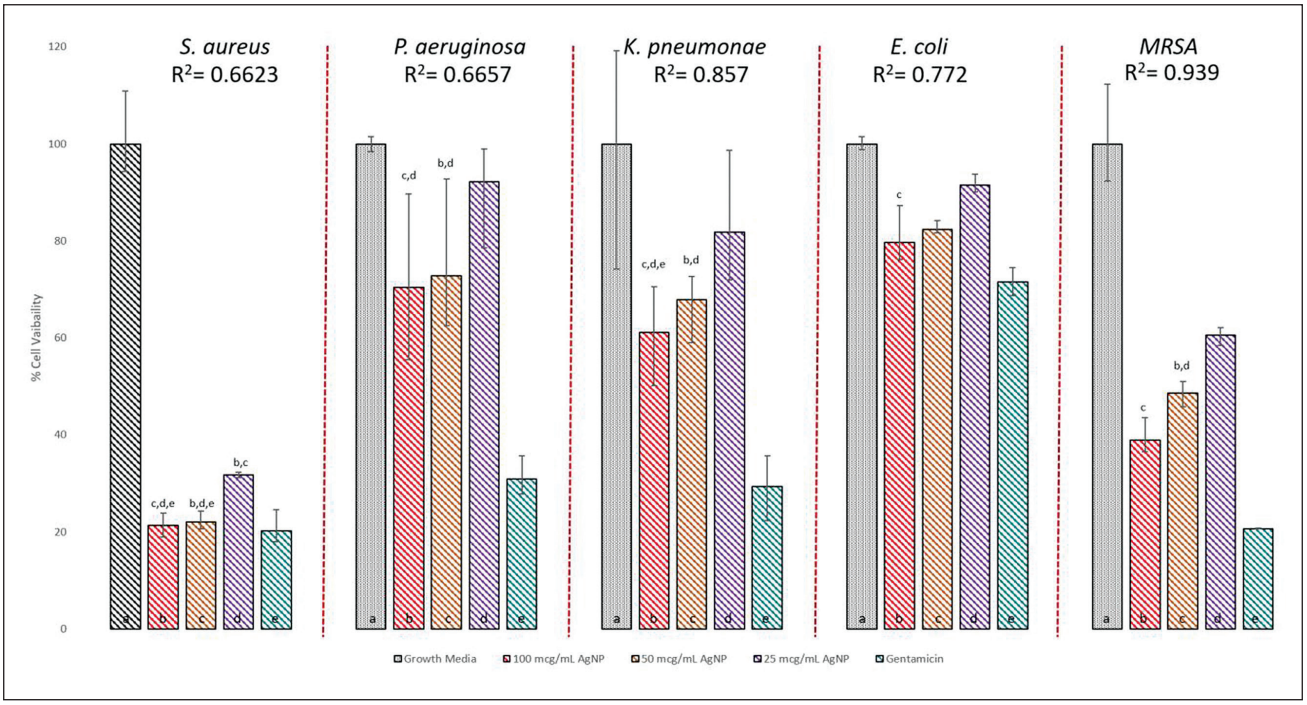

Figure 3. Antibacterial activity of AgNP against ESKAPE isolates.

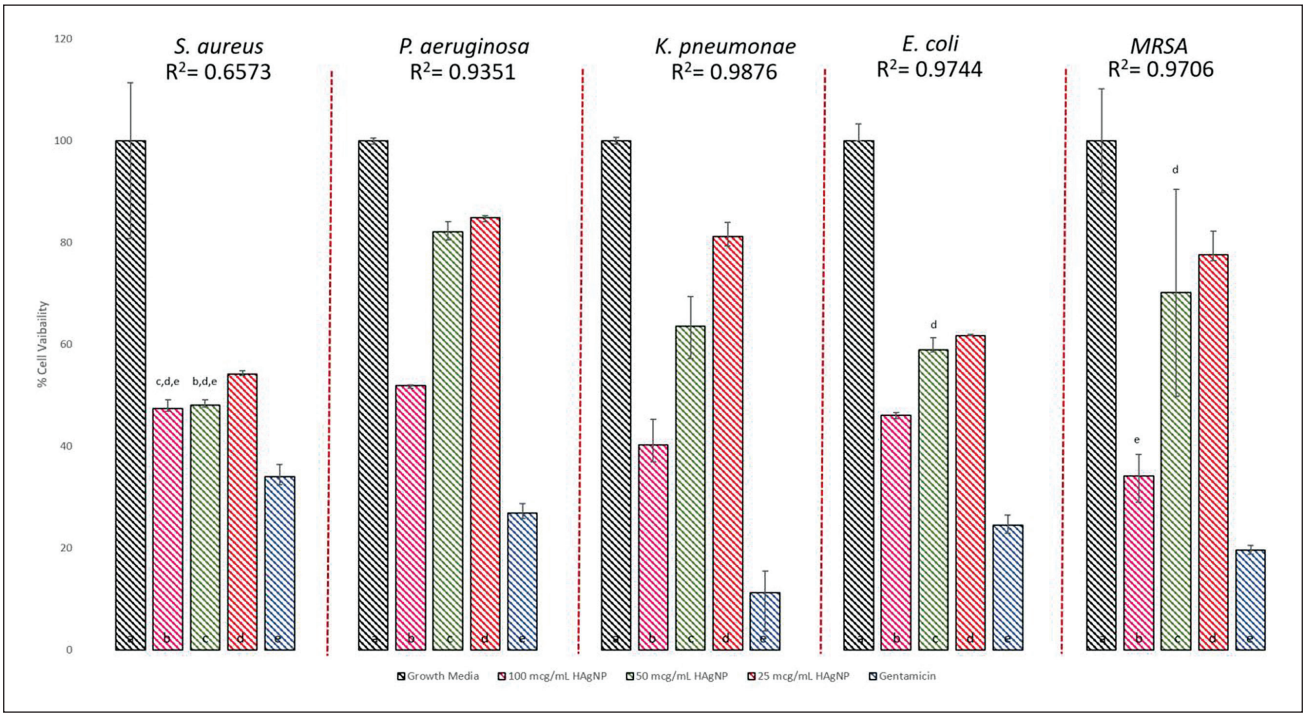

Figure 4. Antibacterial activity of HA-AgNP against ESKAPE isolates.

greater consistency in the antibacterial response. These findings suggest that HA functionalization improved the overall antimicrobial efficacy against multidrug-resistant pathogens.

The AgNP at 100 mcg/mL was able to reduce the bacterial loads of *Staphylococcus aureus (S. aureus), Pseudomonas aeruginosa (P. aeruginosa), Klebsiella pneumonae (K. pneumonae), Escherichia coli (E. coli),* and *Multidrug Resistant Staphylococcus aureus* (MRSA), by approximately 80%, 30%, 40%, 21%, and 60%, respectively. In addition, the AgNP significantly eliminated *S. aureus* at concentrations of 100 mcg/mL and 50 mcg/mL. Lastly, the AgNP showed dose-dependent antibacterial effects on *K. pneumonae, E. coli and MRSA* as shown in Figure 3. It was noted that there was no significant difference between the doses.

HA-AgNP showed moderate antibacterial activity in killing the said clinical isolates, in additional to being more reliably dose-dependent.

On average, 100 mcg/mL of HA-AgNP was able to exterminate 60% of the top five clinical isolates, and, showed dose-dependent antibacterial activity when compared to AgNP alone in all clinical isolates except *S. aureus.* The IC50 values of HA-AgNP were 42.11, 102, 58.5, 63.2 and 65.6 mcg/mL on *Staphylococcus aureus (S. aureus), Pseudomonas aeruginosa (P. aeruginosa), Klebsiella pneumonae (K. pneumonae), Escherichia coli (E. coli),* and *Multidrug Resistant Staphylococcus aureus* (MRSA), respectively, as shown in Figure 4. The stable, dose-dependent antibacterial activity of HA-AgNP can be mainly attributed to hyaluronic acid's ability in stabilizing the particle size of AgNP.

DISCUSSION

In recent years, AgNP have gained much attention as potential antibacterial agents,[28] especially on traumatic wounds and skin lesions which pose a significant cause of infections.[29,30] Silver nanoparticles can help innovate wound care, especially among surgical patients.[31,32] However, particle size is difficult to control during and after synthesis.[33] Silver nanoparticles are unstable after reduction, forming colloidal systems bigger than the expected size, reducing efficacy.[34-36]

Various methods such as mechanical reduction, laser ablation, lithography, and ball milling have been tried, but these reduce the AgNP yield and don't guarantee size uniformity.[37-39] Organic synthesis through enzymatic reduction of fungi, bacteria, and plants can produce AgNPs, but is difficult to control.[40-42] The conventional method of reduction through citric acid, tannic acids, and polysaccharides poses the same problems.[43,44]

Particle stability has been largely improved with the addition of capping agents[45-47] such as tannic acid, luteolin, chitosan, and collagen.[48-51] One study synthesized HA-AgNP as a ligand on radioactive tagging agents. However, its potential as an antibacterial has not yet been explored. Among the various polysaccharide capping agents, HA shows much promise as it also has an innate ability to kill bacteria and acts as a biological tissue cement which aids in wound healing.[52] Hyaluronic acid is composed of N-acetyl-glucosamine, and glucuronic acid, a monosaccharide containing carboxylic acid moiety.[53] Silver derivatives can easily attach to the carboxylate functional group, which can further be reduced to silver alone.[54,55] Collectively, this silver will form a colloid, but the presence of an HA tail enables control of the colloidal formation, which results in AgNPs with excellent physico-chemical and pharmacological properties.[56] In addition, hyaluronic acid acts as a bacteriostatic barrier with a proven long-term safety profile.[57-59]

While many studies have tested AgNP against gram-positive and gram-negative bacteria,[60-68] Pseudomonas and Cronobacter species,[69,70] yeast, and *E. coli*,[71-73] none have tested HA-capped AgNP.

The study tested HA-AgNP and AgNPs antibacterial activity against *S. aureus, P. aeruginosa, K. pneumoniae, E. coli* and Multidrug Resistant *Staphylococcus aureus* (MRSA). Both *S. aureus* and MRSA were highly susceptible to the AgNP at 100 mcg/mL with a bacterial reduction of 80% and 62%, respectively. This is no surprise as AgNP strongly interacts with the abundant peptidoglycan in gram positive bacteria cell walls.[74-77]

CONCLUSION

The HA-AgNP resulted in effective and dose-dependent antibacterial activity in all bacteria except for S. aureus. This enhanced activity is due to the more consistent particle size as hyaluronic acid encapsulated the silver nanoparticles, inhibiting their apparent particle aggregation. The stability was assessed through its dose-dependent antibacterial activity and, theoretically, the particle capping stabilizing properties. However, the study recommends further examination of the particle stability through scanning electron microscopy.

This capped AgNP resulted in better antibacterial activity against *E. coli* and *S. aureus*,[78,79] likely due to the uniform and smaller particle sizes.[80,81] The bactericidal effect of HA-AgNP at 100 mcg/mL on S. aureus and MRSA was statistically comparable with the positive control gentamicin at 2 mcg/mL. The synthesis and antibacterial activity of HA-AgNP showed its potential as a tool in destroying bacteria, enhancing wound healing, and combating antibiotic resistance.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

HGC: Conceptualization, Methodology, Validation, Formal analysis, Resources, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration, Funding acquisition; **SP:** Conceptualization, Methodology, Validation, Formal analysis, Resources, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration, Funding acquisition; **JPS:** Conceptualization, Methodology, Validation, Formal analysis, Resources, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration, Funding acquisition; **RM:** Conceptualization, Methodology, Validation, Formal analysis, Resources, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration, Funding acquisition; **MEMV:** Conceptualization, Methodology, Validation, Formal analysis, Resources, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration, Funding acquisition; **AJ:** Conceptualization,

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AUTHOR DISCLOSURE

The authors declared no conflict of interest.

DATA AVAILABILITY STATEMENT

The datasets generated and analyzed in this study are included in the published article.

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None.

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ORIGINAL ARTICLE

Local Infiltration Analgesia for Postoperative Pain Control following Skin Crease "Bikini Incision" Anterior Total Hip Arthroplasty for Neglected Femoral Neck Fractures: A Double-Blinded Randomized Control Trial

Angelico Gabriel M. Lorena, MD, MBA, DPBO and Joel V. Baron, MD, FPOA

Department of Orthopedic Surgery, Philippine Orthopedic Center, Quezon City, Philippines

ABSTRACT

Background. The incidence of femoral neck fractures continues to increase along with the rise of the elderly population, and in the Philippines, a significant number have become neglected. Total hip arthroplasty (THA) is the treatment of choice for previously healthy and active patients. Local infiltration analgesia is a known adjunct for postoperative pain control, but its effects for THA via the "bikini incision" anterior approach are yet to be established.

Objective. The study primarily aims to determine the effectiveness of local infiltration anesthesia using bupivacaine (as compared to placebo) in reducing acute post-operative pain in adult patients who have undergone THA for a neglected femoral neck fracture via the skin crease "bikini incision" anterior approach.

Methodology. Forty-two patients (21 per treatment arm) aged 50–80 who underwent THA via the said approach were included in a double-blinded randomized control trial (RCT). Modified d'Aubigné-Postel score, pain control on the first two postoperative days, and length of hospital stay were the measured outcomes. Independent Sample T-test, Mann-Whitney U test, and Fisher's exact/Chi-square test were used to determine the differences in mean, rank, and frequency, respectively, between the two groups. Null hypotheses were rejected at 0.05 α-level of significance.

Result. On postoperative day one, the local infiltration anesthesia group had a higher Modified d'Aubigné-Postel median score compared to the placebo group (14 vs. 12, $p = 0.026$). Day one median NRS was also slightly lower versus the placebo group (3 vs. 4, $p = 0.032$). On day two, NRS scores decreased for both groups, and the difference between the groups was not statistically significant (1 vs. 2, $p = 0.203$). The number of rescue doses on both days and the length of hospital stay were not significantly different for both groups. No adverse effects were recorded.

Conclusion. Statistically, local infiltration anesthesia reduces pain only on day one after THA via the anterior "bikini incision" approach for neglected femoral neck fractures. However, clinically, no significant differences in functional and pain scores were observed between the groups. Therefore, local infiltration anesthesia cannot be routinely recommended for post-operative pain management in this population.

Keywords. bikini incision, direct anterior approach, total hip arthroplasty, neglected femoral neck fracture, local infiltration analgesia, bupivacaine

INTRODUCTION

Incidence of femoral neck fractures

In the coming years, with the increasing number of the elderly population, the number of fragility fractures is also expected to rise. Globally, the population of people aged 60 and above is expected to almost double from 12% in 2015 to 20% in 2050. The lifetime risk for fragility fractures is especially high among Asians at 40%, similar to that of coronary heart disease. Of particular interest, hip fracture cases are projected to increase to as many as 6.26 million cases by 2050.[1]

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Corresponding author: Angelico Gabriel M. Lorena, MD, MBA, DPBO
Department of Orthopedic Surgery, Philippine Orthopedic Center, Banawe cor. Ma. Clara St., Brgy. Lourdes, Quezon City, Philippines
E-mail: agmlorenaorthopedics@gmail.com
ORCiD: https://orcid.org/0009-0005-9688-9645

Femoral neck fractures in the elderly should be treated urgently, ideally within 48 hours of admission, to prevent major complications. According to Roshan et al., the odds ratio of mortality increased by 1.27 for a 24-hour delay in surgery.[2,3]

However, given the socioeconomic status of patients seen in a Philippine tertiary government institution and the lingering effects of the global COVID-19 pandemic, a significant number of femoral neck fractures became neglected.

Neglected femoral neck fractures

Literature is scarce because developed countries can treat neglected femoral neck fractures in a more timely and ideal setting. Developing countries like the Philippines, on the other hand, have more patients who receive delayed management for different reasons—financial, geographic, poor health-seeking behaviors, or simply a lack of information regarding these injuries.

An acceptable definition was proposed by Jain in 2015, describing a "neglected femoral neck fracture" as a femoral neck fracture for which 30 days or more have elapsed from the time of injury to the time of first medical consultation.[4] These patients present with shortened, severely externally rotated lower extremities, superiorly displaced greater trochanters, with varying amounts of soft tissue contracture. Main complications include avascular necrosis (AVN) of the femoral head, non-union, and even increased mortality rates. Given their non-ambulatory status, a significant number of these patients also experience functional decline secondary to generalized deconditioning. The treatment of choice for these neglected femoral neck fractures in the previously active, independent elderly patient with good pre-injury status is still total hip arthroplasty (THA).[4]

Local data: Total Hip Arthroplasty (THA) in the Philippine Orthopedic Center (POC)

In the POC, femoral neck fractures constitute 43–46% of patients who underwent primary THA in the adult orthopedic service from 2018–2020, even at the onset of the COVID-19 pandemic (Figure 1). In 2018 alone, 58 cases of neglected femoral neck fractures were treated with primary THA; in 2020, despite difficulties with lockdown restrictions and temporary cessation of elective surgeries, 27 cases were treated and still comprised the majority of THA cases. Following in 2nd and 3rd were cases of degenerative osteoarthritis secondary to dysplastic hip and AVN, respectively.

Anterior approach THA: skin crease "bikini incision"

Given the need to perform THA for neglected femoral neck fractures in the active elderly population, various approaches have been done through the years. Gaining attention in the field of hip arthroplasty is the skin crease or "bikini incision" for the anterior approach THA. The technique was pioneered by Leunig et al in 2012, and the results of their initial study showed better aesthetic appearance (shorter, narrower scars) and decreased risk of dislocation (3.1% vs. 6.9% in the posterior approach).[5] Moreover, functional scores (WOMAC, Oxford hip, and UCLA activity scale scores), the incidence of lateral femoral cutaneous nerve (LFCN) hypoesthesia, operating time, blood loss, and average cup inclination were all comparable with that of the standard anterior approach.

Local Infiltration Analgesia (LIA) as an adjunct for post-operative pain management in THA

Treatment does not end after prosthesis implantation. Control of postoperative pain expedites recovery and improves outcomes.[6] Inadequate pain control has translated to delayed mobilization and rehabilitation, sleep disruption, cognitive dysfunction, increased patient anxiety, increased length of stay, and decreased overall patient satisfaction. The current standard of care usually includes a combination of opioids and non-steroidal anti-inflammatory drugs (NSAIDs) as recommended by Anesthesiology, coupled with an early Rehabilitation protocol. Aside from these, however, there is no universal protocol for adjunctive treatment.

In a meta-analysis of 27 articles, Zhao et al showed that multimodal pain management is effective in post-THA and post-total knee arthroplasty (TKA) patients. One of the modalities highlighted was local infiltration analgesia (LIA),

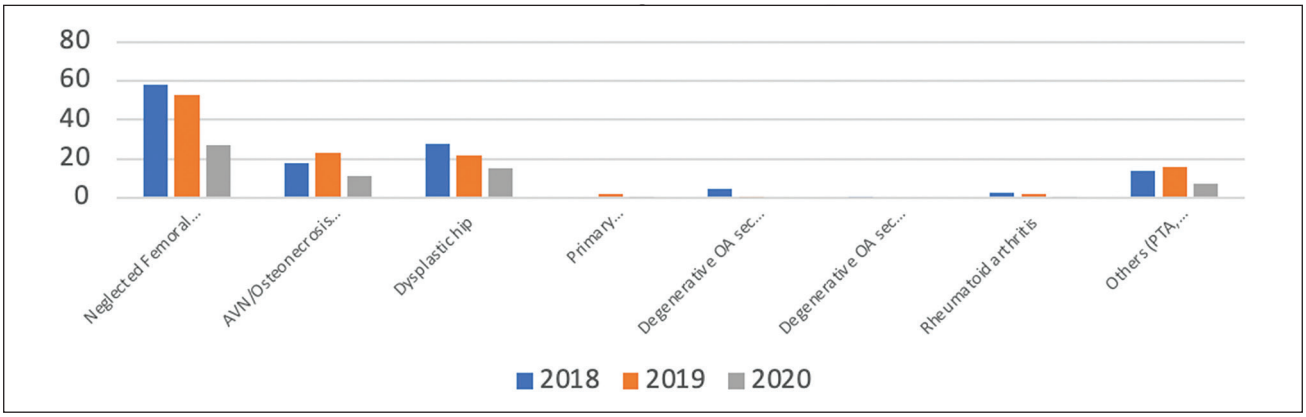

Figure 1. Indications for Primary THA in the POC Adult Orthopedics Service, 2018-2020.

which relieves pain, improves range of motion (ROM), shortens the length of stay, decreases opioid consumption, and promotes early mobilization.[6]

LIA as an adjunct therapy for hip and knee arthroplasty was first reported by Kerr in 2008, in a case series of 325 post-THA/TKA/hip resurfacing patients. The original mixture for LIA comprised ropivacaine (Naropin) 2.0 mg/mL, ketorolac (Toradol) 30 mg, and epinephrine 10 ug/mL.[7] The concoction was diluted with 0.9% normal saline to achieve a volume of 150 to 200 mL (depending on the weight). The solution was equally distributed in three different locations during surgery, namely: 1) around the acetabular rim after insertion of the acetabular component; 2) into the external rotators, gluteus tendon, and iliotibial band after insertion of the femoral component; and 3) into the subcutaneous tissues under the wound before skin closure.

No adverse events were seen attributable to the LIA, and pain scores were generally at 0 to 3/10 at rest and while walking. Moreover, no patients required morphine after day one and all patients were discharged after a single overnight stay, suggesting that LIA can potentially be used as an adjunct to achieve adequate postoperative pain control.[7]

More than a decade later, Tan published a randomized control trial (RCT) which used LIA for patients who underwent THA using the anterior approach. They used ropivacaine alone and distributed the anesthetic (or the 0.9% saline for the placebo group) in two planes.[8]

Results of their study showed no statistically or clinically significant difference in the median quality of recovery score on day one post-op, no significant difference in worst pain scores, opioid consumption, and time to mobilization, and there were no local anesthetic toxicity complications for either group.[8] They concluded that perhaps anterior THA was an inherently less painful procedure compared to the other approaches, hence the short-acting effect of pure ropivacaine was not detectable. It is unclear, however, what the results would have been if the LIA was prepared as described by Kerr.

Local anesthetics: general information, additives, toxicity

Local anesthetics cause anesthesia and analgesia by blocking pain sensation along the nerve fibers. This is achieved by targeting voltage-gated Na^+ channels, and their effect can be increased by epinephrine, opioids, and alpha 2-adrenergic agonists. Epinephrine is a vasoconstrictor that prolongs the local anesthetic block in a dose-dependent manner, increases the intensity of the block, and decreases systemic absorption. Opioids work through synergistic analgesia, which also enhances and prolongs the local anesthetic block.[9]

The rate of systemic absorption and peak plasma level are directly proportional to the dose of local anesthetic in a nearly linear relationship. Treatment options for systemic effects are generally supportive, starting with oxygenation and ventilation, followed by anti-seizure medications (for neurologic complications), and lastly, intravenous infusion of lipid emulsion (for cardiovascular events).[9]

Local anesthetics: bupivacaine vs. ropivacaine

While ropivacaine has been widely used, bupivacaine has not been reported for LIA. Ropivacaine is not readily available in our tertiary government hospital in the Philippines, but a similar drug in its class, bupivacaine, is a staple in most pharmacies along with lidocaine.

According to Barash et al., bupivacaine and ropivacaine have the same potency on peripheral nerves (3.6). Both local anesthetics also have a fast onset of action and comparable durations (2–8 hours for bupivacaine vs. 2–6 hours for ropivacaine). Bupivacaine, however, has a slightly higher relative potency for central nervous system toxicity (4.0 vs. 2.9 in ropivacaine), which can be avoided by administering appropriate weight-based doses. In adults, the recommended maximum single dose for bupivacaine is 175 mg but increases to 225 mg with epinephrine, while the maximum single dose for ropivacaine is 200 mg.[9]

Jacob et al. tested lidocaine, bupivacaine, and ropivacaine in terms of efficacy for pain control and their effects on chondrocytes. While analgesic effects were equal, ropivacaine was the least toxic to chondrocytes. This is perhaps another reason why previous studies opted for ropivacaine for LIA.[10]

Functional outcome: Modified d'Aubigné-Postel Score

Lastly, to measure the functional outcomes of post-operative patients in the study, the Modified d'Aubigné-Postel Score was assessed 24 hours postoperatively (Table 1). The original scale was developed in 1954 for post-hip arthroplasty patients, and it was modified in 1986. The scores from each parameter (pain, ambulation, and range of motion) are added to provide an overall score, with the clinical interpretation as follows: *18 Excellent, 15–17 Good, 12–14 Fair,* and *3–11 Poor*. Aside from its simplicity, this score was also chosen because it focused on the key goals of arthroplasty—pain relief, improved mobility, and walking ability.[11]

Table 1. The Modified d'Aubigné-Postel Score

Score	Pain	Ambulation	Range of motion (%)
6	No pain	Normal	95–100
5	Slight or intermittent	No cane, but slight limp	80–94
4	Pain after ambulation, but disappears	Long distances with cane or crutch	60–79
3	Moderately severe, permits ambulation	Limited, even with support	40–59
2	Severe with ambulation	Very limited	20–39
1	Severe, prevents ambulation	Bedridden	0–19

Relevance/Rationale

With the increasing prevalence of femoral neck fractures brought about by the growing population of active elderly patients, the number of total hip arthroplasties will continue to rise. In a government tertiary hospital in the Philippines, a significant number of these cases will inevitably be neglected. As arthroplasty surgeons aim to bring these patients back to their pre-injury status, total hip arthroplasties will be chosen more often. In line with this, adequate post-operative pain control helps patients mobilize earlier and recover faster.

Moreover, there are currently no studies on alternative local anesthesia agents, particularly bupivacaine, which is more readily available. The outcomes and differences with ropivacaine, if there are any, would contribute new information in this field as well.

OBJECTIVES

General objective

The study primarily aimed to determine the effectiveness of LIA (as compared to placebo) in reducing acute postoperative pain in adult patients who underwent THA for a neglected femoral neck fracture via the skin crease "bikini incision" anterior approach.

Specific objectives

Specifically, the study aimed to determine the relationship between the use of intraoperative LIA in skin crease "bikini incision" anterior THA for neglected femoral neck fractures and the following:

1. Modified d'Aubigné-Postel scores – measured on day one post-operative[7,8]
2. Pain control on day one post-operative (measured with the NRS and number of rescue doses of pain meds)
3. Pain control on day two post-operative (measured with the NRS and number of rescue doses of pain meds)
4. Length of hospital stay (number of days from the end of surgery to discharge)

METHODOLOGY

Research design and sampling method

The study was a double-blinded randomized control trial (RCT) following the CONSORT 2010 checklist and flow-chart, in which neither the patient nor the primary surgeon/surgical team were informed regarding the group the patient was randomized into. The patients aged 50–80 years old, weighing more than 50 kg, who underwent unilateral THA via the skin crease anterior approach by a single surgeon for a neglected femoral neck fracture (defined as a femoral neck fracture for which surgery was done 30 days or more from the time of injury) were included in the study. All surgeries were done by a single surgeon assisted by an arthroplasty fellow and several orthopaedic residents. Convenience sampling was done as patients were consecutively recruited as they were seen in the Adult Orthopedics Outpatient Department. The study underwent review and was approved by the institution's Ethics Review Board (ERB) before data was gathered.

Definition of exposure and outcome

The treatment (exposure) group received LIA (3 ampules of bupivacaine isobaric 50 mg/amp, 1 ampule of ketorolac 30 mg/amp, and 1 ampule of epinephrine 1 mg/amp diluted with 170 mL of 0.9% saline). All formulations were safely within the maximum dose of bupivacaine (225 mg with epinephrine). The placebo (control) group was given 200 mL of 0.9% saline only. The outcome measures were as follows:

1. Modified d'Aubigné-Postel scores – measured on day one (24 hours postoperatively)
2. Pain control on postoperative day one – measured using the numerical rating scale (NRS) and number of rescue doses of pain meds taken within the first day
3. Pain control on postoperative day two – measured with the NRS and number of rescue doses of pain meds taken within the second day
4. Length of hospital stay – defined as the number of days from the end of surgery to discharge

Inclusion and exclusion criteria

All patients aged 50–80 years old, weighing more than 50 kg, who underwent unilateral total hip arthroplasty (THA) via the skin crease "bikini incision" anterior approach for neglected femoral neck fractures, and who were active and mobile pre-injury (independent community ambulators with or without assistive devices) were included in the study. Exclusion criteria were the following: history of prior hip surgery on the ipsilateral hip, ipsilateral knee and/or spine pathology (e.g., arthrodesis), patients who had limited ambulation pre-injury, major medical comorbidity with high-risk for intra- or postoperative complications (e.g. cardiovascular disease, chronic liver disease, or chronic kidney disease), patients who needed to undergo peripheral nerve blocks pre- and post-operatively, patients with known allergies to bupivacaine and/or NSAIDs, and patients diagnosed with chronic regional pain syndrome (CRPS).

Data gathering and sample size computation

Sample size computation

Using G*Power 3.1.9.2, a computed minimum sample size of 42 patients were required for this study based on the desired large (0.90) effect size between patients under LIA and placebo in terms of any of the study outcomes. This computation also accounted for a 5% level of significance and 80% power. Participants were equally allocated for both the treatment group and placebo group, with 21 patients in each arm.

At the time of calculating the sample size, no existing studies compared LIA with placebo in terms of Modified d'Aubigné-Postel scores, pain control, and length of hospital

stay. Given this limitation, the statistician and author made an informed assumption for the effect size (0.90) based on clinical experience and analogous studies in similar contexts. This estimate was intended to be as close as possible to what is observed in actual clinical practice.

The choice of an effect size of 0.90 and a power of 80% was a pragmatic decision, balancing the need for statistical accuracy with the practicalities of the study design. While the sample size of 42 may appear small, it was determined based on the best available estimates at the time, recognizing the need for further research to validate these findings on a larger scale.

Pre-operative

Data was gathered via the convenience sampling method. Patients seen at the Adult Orthopedics Outpatient Department who met the inclusion criteria were recruited for the study and were informed that the study would be double-blinded. Informed consent was secured by either the researcher or the doctor-in-charge (DIC). Patients were admitted one to two days before surgery upon fulfillment of standard pre-operative requirements (e.g., cardiopulmonary and other necessary medical clearances, COVID testing, etc.). Pre-operative orders were standardized for all patients, which included the following medications:

1. Omeprazole 40 mg IV once on *nil per orem* (NPO)
2. Tranexamic acid 1 g IV every 12 hours for 3 doses starting 12 MN
3. Paracetamol 1 g IV every 6 hours

Medications needed for either the LIA or the placebo were ordered for all patients at the ward, so that they could be randomly allocated into either group upon arrival at the OR. Anesthesia service was also informed regarding the patient's participation and were blinded to the assigned treatment. The pre-induction medications were also standardized among all patients, as discussed with the anesthesia service. Lastly, a blank Data Collection Form was then attached to all participants' charts upon admission.

Intraoperative

The following standard pre-induction medications (weight-dependent doses) were given upon arrival at the OR and after assessment of the initial vital signs:

1. Midazolam 0.5–1 mg IV, and
2. Fentanyl 0.25–50 mcg IV

The standard anesthesia for THA patients was neuraxial-spinal anesthesia (weight-dependent doses) with either of the following local anesthetics:

1. Bupivacaine 0.5% Heavy 16–18 mg, or
2. Bupivacaine 0.5% Isobaric 16–18 mg

The following adjuncts were also given alongside the spinal anesthesia:

1. Fentanyl 12.5–25 mcg and
2. Epinephrine 0.1–0.2 mg

Once the patient was induced at the OR, the following medications were given:

1. Cefazolin 2 g IV loading dose
2. Dexamethasone 4 mg IV

Before the surgery, the patient was assigned to either the LIA group or the placebo group using a table of random numbers from 01 to 42—if the patient was assigned to an even number, he/she was assigned to the LIA group; on the other hand, the patient was enrolled in the placebo group if an odd number was drawn. This information was disclosed only to the circulating nurse, scrub nurse, and the section chief resident (if the researcher was not physically present at the OR). The primary surgeon, the rest of the surgical team, as well as the anesthesiologists, were not informed about the patient's assignment. The patient's assignment was recorded by the researcher on a separate list and was not written on the data collection form to avoid bias from the doctor-in-charge upon data gathering at the ward.

The circulating and scrub nurses then prepared the appropriate solution. For the LIA group, the exact concoction used was a modification of Kerr's original treatment:[7]

1. Bupivacaine 0.5% isobaric 50 mg/amp, 3 ampules (total of 150 mg)
2. Ketorolac 30 mg/amp, 1 amp
3. Epinephrine 1 mg/amp, 1 amp

These components were then diluted with 0.9% saline to complete 200 mL in a kidney basin. On the other hand, for the placebo group, 200 mL of plain 0.9% saline was prepared. The infiltrate was prepared by the scrub nurse under the supervision of the researcher, section chief resident, and/or the circulating nurse, without disclosing the contents to the rest of the surgical team. Another circulating nurse confirmed the contents of the solution prepared by checking the ampules opened.

All surgeries then proceeded as in the routine fashion via the skin crease "bikini incision" anterior approach. After prosthesis implantation and with deep retractors still applied, the main surgeon requested the solution. Using a 50 cc syringe, a gauge 19 needle, and slow incremental injection with aspiration, half of the prepared solution (100 mL) was injected into muscles in the subfascial plane (tensor fascia lata, anterior border of gluteus medius, upper anterior border of the vastus lateralis, medially into adductors along the medial margin of the acetabulum, and rectus femoris) (Figure 2). The remaining half (100 mL) was infiltrated with multiple passes into the subcutaneous tissues after deep fascia closure. Routine closure of subcutaneous layers and skin with absorbable sutures and sterile staples, respectively, was done.[8]

The New York School of Regional Anesthesia (NYSORA) treatment algorithm is the standard of care to treat local anesthetic systemic toxicity (LAST) detected intra-operatively (e.g., lightheadedness, tinnitus, oral numbness, seizures, unconsciousness, decreased sensorium, or cardio-respiratory depression/arrest as evidenced by unstable vital signs).

Adequate oxygenation, seizure cessation, and lipid emulsion therapy are the cornerstones of management.[12] In case of toxicity, the surgery would be suspended while treat-ment was being administered and continued once deemed safe by the anesthesiologist, and monitoring would continue up to 24 hours postoperatively. The patient would also be referred to the cardiology and/or neurology services (depending on the patient's symptoms) (Figure 3).

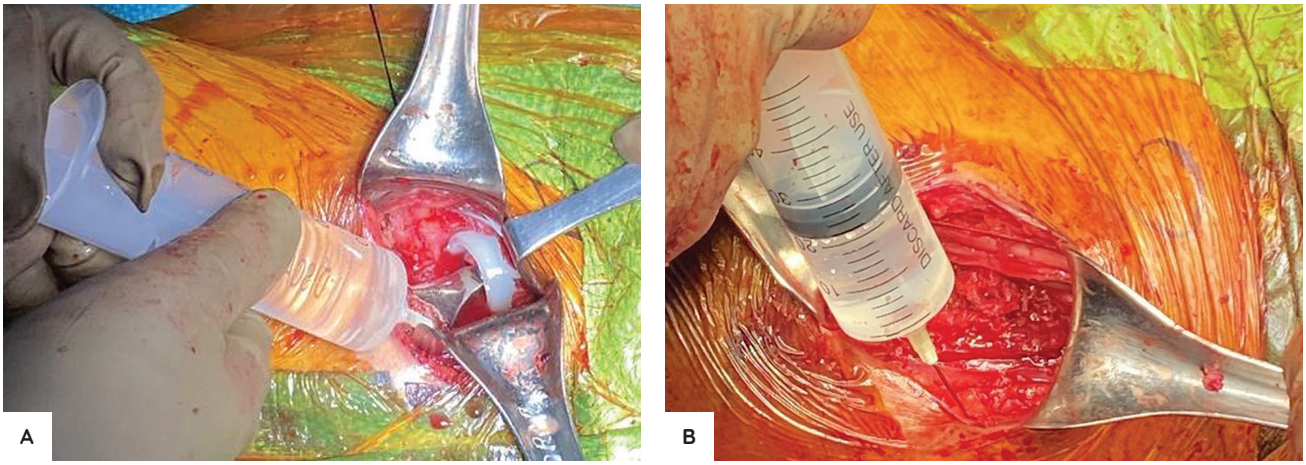

Figure 2. Intraoperative images: infiltrating 100 mL of the solution into the subfascial plane **(A)**, and the remaining 100 mL into the subcutaneous plane **(B)** before closure.

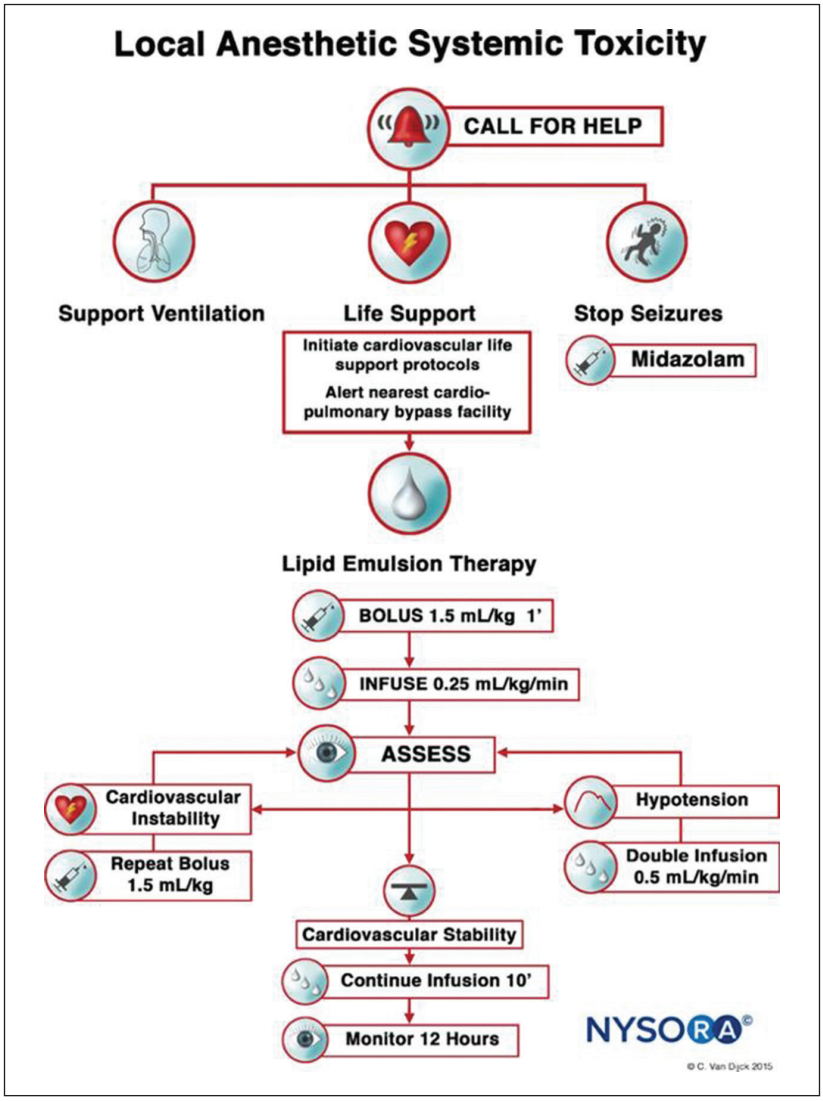

Figure 3. Algorithm for management of local anesthetic systemic toxicity.[12]

Post-operative

Post-operative medications in the recovery room were standardized across all patients:

1. Cefazolin 1 g IV every 6 hours for 4 doses, then shift to co-amoxiclav 625 mg/cap, 1 cap every 8 hours for 14 days
2. Ketorolac 30 mg IV every 8 hours for 3 doses
3. Tramadol 50 mg IV every 6 hours for 3 doses
4. Paracetamol 1 g IV every 8 hours for the first 24 hours
5. Ondansetron 4 mg IV every 8 hours for nausea/vomiting

The standard opioid rescue medication for breakthrough post-operative pain was:

1. Tramadol 50 mg IV every 4–6 hours as needed for severe pain (pain scale/numerical rating score (NRS) ≥4/10) with a maximum dose of 400 mg/day, to be given within 15 minutes of the patient's verbalization of severe pain

All patients were instructed on precautions to prevent anterior hip dislocation. In the post-anesthesia care unit (PACU), vital signs were monitored, the post-op site was inspected, and ambulation was initiated. Numerical rating score (NRS) was recorded by the nurses as part of the standard vital signs monitoring for all post-operative patients (every 15 minutes for 2–3 hours, then every 30 minutes for 1–2 hours, then every hour until the postoperative 24th hour). Any adverse reactions or symptoms of LAST were also monitored. Any allergic reactions were treated with antihistamines (Cetirizine 10 mg/tab, 1 tab PO) or Epinephrine 0.5 mg IM.

The Data Collection Form was filled up by the resident doctor-in-charge at the ward. The Modified d'Aubigné-Postel and NRS scores (average of the hourly NRS score for the first 24 hours) and the number of rescue doses received by the patient for breakthrough pain (i.e., Tramadol 50 mg IV, as detailed above) were recorded 24 hours postoperatively. The NRS score and number of rescue doses for breakthrough pain were again recorded on postoperative day two (postoperative 48th hour).

Lastly, the length of stay was recorded for each patient, defined as the number of days spent at the hospital from the end of the surgery until the time of discharge. Take-home medications were also standardized for all patients, as follows:

1. Co-amoxiclav 625 mg/cap 1 cap every 8 hours for 2 weeks
2. Paracetamol 500 mg/tab 2 tabs every 6 hours round-the-clock (RTC)
3. Tramadol 50 mg/tab 1 tab every 8 hours RTC
4. Etoricoxib 120 mg/cap 1 cap once a day as needed for breakthrough pain
5. Omeprazole 40 mg/tab 1 tab

Regular follow-ups were standardized at 1 week, 2 weeks, 1 month, 3 months, 6 months, and yearly post-operatively. No other data was collected during these follow-up visits to the Outpatient Department.

Statistical tools

Descriptive statistics were used to summarize the demographic and clinical characteristics of the patients. Frequency and proportion were used for categorical variables, median and interquartile range (IQR) for non-normally distributed continuous variables and mean and SD for normally distributed continuous variables. Independent Sample T-test, Mann-Whitney U test, and Fisher's exact/Chi-square test were used to determine the difference of mean, rank, and frequency, respectively, between the LIA and Placebo groups. All statistical tests were two-tailed tests. Shapiro-Wilk test was used to test the normality of the continuous variables. Missing values were neither replaced nor estimated. Null hypotheses were rejected at 0.05 α-level of significance. STATA 13.1 was used for data analysis.

RESULT

A total of 42 participants were included in the study, with a mean age of 71.33 ± 6.01 years. Among the participants, 39 (92.86%) were female and 24 (57.14%) sustained a neglected femoral neck fracture on the left side. Among the demographic variables, no significant difference was noted between the two groups (Table 2). As for the medical and surgical profile of the patients, the majority of patients were hypertensive (71.43%) and 40.48% were diabetics. The majority of the patients had been operated on within 6 months of their injury (88.1%), and all implants were cementless total hip arthroplasty implants. Lastly, the surgeries lasted for a mean duration of 82.67 ± 6.79 minutes. There was no significant difference between the two groups in terms of medical and surgical parameters (p >0.05) (Table 3).

In terms of the post-operative parameters, the main variables of interest were the Modified d'Aubigné-Postel score, NRS, and the number of rescue doses received by the patients on postoperative days one and two. Across both groups, the median Modified d'Aubigné-Postel score was 12 (IQR 11–14) out of the highest possible score of 18, which is interpreted as *Fair*.

While the median NRS differed by one point between the two groups (placebo NRS 4 vs LIA NRS 3), several participants under the placebo group had a higher average NRS on the first postoperative day (placebo IQR 3–6 vs. LIA IQR 2–4), and the p-value for the said variable was significant at 0.032, implying a significant difference between the two groups (Table 4).

Regardless of the treatment group, most patients (31) received 0–1 rescue doses of Tramadol within the first postoperative day. While 12 LIA patients received at least one rescue dose compared to 16 patients from the placebo group, there was no significant difference between the two groups (p = 0.582) (Table 4).

On the second postoperative day, the NRS scores were generally lower compared to the previous day. The LIA group's NRS score was still one point lower, but there was no significant difference between the two groups (p = 0.203). The number of rescue doses requested on the second day also decreased. While two patients from the LIA group required

Table 2. Demographic and clinical profile of the patients

	Total (*n* = 42)	LIA (*n* = 21)	Placebo (*n* = 21)	*P*-value
	Frequency (%); Mean ± SD			
Age, years	71.33 ± 6.01	72.33 ± 5.85	70.33 ± 6.15	0.287
Sex				0.232
Male	3 (7.14)	3 (14.29)	0	
Female	39 (92.86)	18 (85.71)	21 (100)	
Civil status				1.000
Single	6 (14.29)	3 (14.29)	3 (!4.29)	
Married	22 (52.38)	11 (52.38)	11 (52.38)	
Separated	1 (2.38)	0	1 (4.76)	
Widowed	13 (30.95)	7 (33.33)	6 (28.57)	
Neglected femoral neck fracture				1.000
Left	24 (57.14)	12 (57.14)	12 (57.14)	
Right	18 (42.86)	9 (42.86)	9 (42.86)	

Table 3. Medical and surgical profile of the patients

	Total (*n* = 42)	LIA (*n* = 21)	Placebo (*n* = 21)	*P*-value
	Frequency (%); Mean ± SD			
Comorbidities				
Hypertension	30 (71.43)	15 (71.43)	15 (71.43)	1.000
Diabetes mellitus	17 (40.48)	11 (52.38)	6 (28.57)	0.208
Dyslipidemia	10 (23.81)	5 (23.81)	5 (23.81)	1.000
Stroke/ CVA	4 (9.52)	3 (14.29)	1 (4.76)	0.606
Time between injury to surgery				1.000
≤6 months	37 (88.1)	18 (85.71)	19 (90.48)	
>6 months	5 (11.9)	3 (14.29)	2 (9.52)	
Type of Anterior THA done				1.000
Cementless	42 (100)	21 (100)	21 (100)	
Cemented	0	0	0	
Duration of surgery, minutes	82.67 ± 6.79	83.38 ± 7.06	81.95 ± 6.60	0.502

at least two rescue doses and no patient in the placebo group needed rescue doses on the second day, there was no significant difference between the groups ($p = 0.855$) (Table 4).

All patients were discharged within three days after surgery with the majority being discharged after two days (57.14%) with no significant difference between the two groups ($p = 0.729$) (Table 5). There was one report of a patient under the LIA group who had lightheadedness on postoperative day two. This patient had a total of six rescue doses of Tramadol within the admission, which is known to cause nausea/ dizziness/ lightheadedness in excessive doses. After discontinuing tramadol, the patient's symptoms resolved. No adverse effect attributable to LIA was recorded throughout the study period.

DISCUSSION

The demographic of our population was typical of patients who sustain femoral neck fractures. Females were also noted to comprise the majority of the participants (92.86%), reflecting the increased risk of osteopenia and fragility fractures in women as they become menopausal. The majority of patients also had other comorbidities such as hypertension and type 2 diabetes mellitus, which was not significantly different across both groups.

A minority of our patients (n = 5) were operated on more than six months from the time of injury. This could be attributed to the increasing accessibility of surgery across the country as COVID restrictions were lifted in 2023.

The study was able to determine the effectiveness of LIA (as compared to placebo) in reducing acute post-operative pain in adult patients who have undergone THA for a neglected femoral neck fracture via the skin crease "bikini incision" anterior approach.

In terms of functional scoring (Modified d'Aubigné-Postel score), patients in the LIA group had higher scores (14 vs. 12, $p = 0.026$) compared to the placebo group. While statistically significant, clinically, both median scores are classified as *Fair*.[11] It is difficult to see whether an improvement of one parameter is directly attributable to the use of LIA. Other factors that may affect the functional score include the individual patient's physiological age, pain tolerance, and time between injury and operation (Table 4).

In terms of the NRS or pain control on the first postoperative day, there was also a statistically significant difference between the LIA and placebo group, with the LIA group having a *lower* rating compared to the placebo group (3 vs. 4, $p = 0.032$). This difference is also clinically not as significant since the NRS scores are close. Corollary to that, the number of rescue doses is similar between the two groups. Regardless of which group they were in, the majority of patients still did not need a rescue dose of Tramadol, showing that having LIA does not necessarily translate to decreased breakthrough

pain. In fact, two patients from the LIA group needed at least two rescue doses; no patients in the placebo group requested more than one rescue dose (Table 5). These findings were also consistent with the conclusions of Kerr and Tan.[7,8]

Across both groups, there was also a noticeable decrease in the NRS from day one to two. Several reasons are postulated for this gradual reduction in pain as a function of time. First, it is possible that the anesthetic effect of LIA was only effective for the first 24 hours, since bupivacaine as a standalone infiltrate is known to have a fast onset of action but a duration of only 2–8 hours (ropivacaine, on the other hand, lasts only 2–6 hours). Epinephrine is known to extend the local anesthetic block of most local anesthesia by counteracting its intrinsic ability to vasodilate vessels. Combined with bupivacaine, systemic absorption is reduced by 10–20%. Interestingly, most studies do not support the routine use of epinephrine with ropivacaine, which is the local anesthetic of choice for LIA in most literature.[9]

Second, all participants in the study (regardless of the group they belong to) typically start physical therapy several hours after surgery and are generally expected to stand and ambulate with a walker. Early initiation of physical therapy (PT) within the first few hours post-operatively is known to decrease post-operative pain and aid in earlier recovery. In a study by Kirkness et al, patients enrolled in an early start PT program (<9 weeks postoperatively) had significantly better pain scores and functional outcomes compared to their late start (>9 weeks) counterparts.[13] Since the postoperative protocol was standardized for both groups, the PT sessions could have been a major contributor to the general decrease in NRS for both groups.

Third, the reduction in pain might be attributable to the direct anterior approach itself. In a retrospective cohort study by Seah et al, the direct anterior approach was associated with the least amount of post-operative opioid consumption in patients who underwent primary THA for osteoarthritis compared to the standard lateral (21% more opioid use) and posterior approaches (18.7% more opioid use). This was attributed to the anterior approach being a muscle-sparing approach, in which less inflammatory cytokines are released since no muscle groups are surgically disrupted and no tendons are detached. Repair of muscles or tendons associated with the posterior and lateral approaches also causes further post-operative pain as these structures are placed in tension once patients start physical therapy.[14]

Lastly, the study conducted a comparative analysis rather than an association study, hence, testing for confounders was not part of the original analysis plan. However, the researcher acknowledges that certain factors, such as individual pain tolerance, psychological variables, duration from injury to surgery, access to rescue doses, and early postoperative rehabilitation protocol for both groups could have potentially influenced the outcomes. While these factors are challenging to quantify and were not explicitly controlled for in this study,

Table 4. Post-operative parameters of the patients

	Total (*n* = 42)	LIA (*n* = 21)	Placebo (*n* = 21)	*P*-value
	Frequency (%); Median (IQR)			
Day 1 Post-operative				
Modified d'Aubigné-Postel score	12 (11 to 14)	14 (12 to 14)	12 (10 to 13)	0.026
NRS	4 (3 to 5)	3 (2 to 4)	4 (3 to 6)	0.032
Number of rescue doses				0.582
None	15 (35.71)	9 (42.86)	6 (28.57)	
1 rescue dose	16 (38.1)	6 (28.57)	10 (47.62)	
2 rescue doses	8 (19.05)	4 (19.05)	4 (19.05)	
3 rescue doses	3 (7.14)	2 (9.52)	1 (4.76)	
Day 2 Post-operative				
NRS	2 (1 to 3)	1 (1 to 2)	2 (1 to 4)	0.203
Number of rescue doses				0.855
None	30 (71.43)	14 (66.67)	16 (76.19)	
1 rescue dose	10 (23.81)	5 (23.81)	5 (23.81)	
2 rescue doses	1 (2.38)	1 (4.76)	0	
3 rescue doses	1 (2.38)	1 (4.76)	0	

Table 5. Clinical outcomes of the patients

	Total (*n* = 42)	LIA (*n* = 21)	Placebo (*n* = 21)	*P*-value
	Frequency (%)			
Length of hospital stay, days				0.729
1	4 (9.52)	1 (4.76)	3 (14.29)	
2	24 (57.14)	13 (61.9)	11 (52.38)	
3	14 (33.33)	7 (33.33)	7 (33.33)	
Adverse effects				
Neurologic	1 (2.38)	1 (4.76)	0	1.000
Cardiovascular	0	0	0	-
Respiratory	0	0	0	-
Allergic	0	0	0	-
Others	0	0	0	-

they are important clinical considerations in the evaluation of LIA.

As for the safety profile of bupivacaine, no adverse effects were noted in any of the participants of the study. One case of lightheadedness was reported, however, in a participant from the LIA group (Table 5). On further analysis, the symptoms could be attributed to the fact that the patient had a total of six rescue doses of Tramadol, which is known to have nausea as an adverse reaction. The specific reason behind the high number of rescue doses was not elucidated. The rest of the participants in the LIA group did not report any adverse effects, which could help support bupivacaine as an effective and safe alternative to ropivacaine.[10]

For all participants in the study, discharge criteria included good pain control, the ability to stand and ambulate with a walker, restoration of hip range of motion, and a dry, well-coaptated wound with no signs of infection. Length of hospital stay was not significantly different in both groups, which shows that the use of LIA does not necessarily translate to a shorter hospital stay. NRS was not the sole factor for discharge; the reduction of pain from day zero to the day of discharge was more important than the actual NRS on the day of discharge itself. Unstable medical issues and wound healing concerns usually influence the decision to discharge patients, but such factors were not observed.

The study is not without several limitations. First, a larger sample size would be better to provide a more generalizable picture of the effects of LIA on patients who undergo skin crease "bikini incision" direct anterior total hip arthroplasty. Second, the population of acute hip trauma patients (ideally within 48 hours to 1 week of injury) should be considered as these injuries tend to be more acutely painful. Third, the population with degenerative osteoarthritis or non-traumatic etiologies would help determine if LIA would also be effective for different pain generators. Fourth, in terms of methodology, it would be ideal if a single data collector is available to eliminate all potential inconsistencies or biases during data gathering.

Lastly, for future studies, it would be recommended to include the assessment of pain control at 6–8 hours post-operatively to consider the effect of LIA and the advantages of the direct anterior approach and to consider the number of post-operative hours that have elapsed before a rescue dose is administered. Moreover, it would be prudent to add additional outcomes such as standing and sitting tolerance, distance walked after surgery, or even the ability to do activities of daily living (ADLs).

CONCLUSION

From a statistical standpoint, LIA was effective in reducing pain only on postoperative day one in adult patients who underwent THA for a neglected femoral neck fracture via the skin crease "bikini incision" anterior approach. Patients in the LIA group had statistically significant higher Modified d'Aubigné-Postel scores and lower median NRS scores on postoperative day one. Pain control on day two and length of hospital stay were not statistically significant between the two groups, suggesting that the benefits of using LIA do not go beyond 24 hours. In the clinical setting, however, there was no significant difference in functional and pain scores between the two groups. Therefore, LIA as an additional method for post-operative pain management in this population cannot be routinely recommended at this time.

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STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

AGML: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration; **JVB:** Methodology, Investigation, Resources, Writing – review and editing, Supervision

AUTHOR DISCLOSURE

The authors declared no conflict of interest.

DATA AVAILABILITY STATEMENT

The Data Collection Form is available upon request from the corresponding author.

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None.

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ORIGINAL ARTICLE

Prevalence of and Factors Associated with MRSA among Patients with Hand Infection Treated in a Public Tertiary Hospital

Tristan Jay I. Arellano, MD,[1] Jessica Anne A. Gandionco, MD,[1] Madonna C. Morales-Valenzuela, MME[2]

[1]*Department of Orthopaedics, Jose B. Lingad Memorial General Hospital, San Fernando, Pampanga, Philippines*
[2]*Data Analytics Unit, Jose B. Lingad Memorial General Hospital, San Fernando, Pampanga, Philippines*

ABSTRACT

Background. Methicillin-resistant *Staphylococcus aureus* (MRSA) poses significant challenges in managing hand infections, especially in resource-limited settings like the Philippines. Despite its global prevalence, data on MRSA-specific hand infections in Filipino patients remain scarce. This study aimed to determine the prevalence of MRSA and identify associated factors among patients treated for hand infections at a public tertiary hospital.

Methodology. A retrospective, cross-sectional study was conducted at Jose B. Lingad Memorial General Hospital from February 2022 to January 2024. Data from 233 patients treated for hand infections were analyzed. Variables examined included demographics, employment status, infection etiology, comorbidities, traditional medicine use, infection location, and classification. Statistical analyses were performed to identify associations with MRSA.

Result. MRSA prevalence was 30% and was significantly associated with etiology (bite wounds being the most common), traditional medicine use ($p = 0.002$), location of infection (ring finger and thumb being most common, $p = 0.001$) educational attainment (with unschooled individuals having a higher prevalence, $p = 0.027$). Other variables, such as age, gender, employment, comorbidities, and infection type, did not show significant associations.

Conclusion. This study highlights the high prevalence of MRSA in hand infections, with traditional medicine use and bite wounds as key risk factors. The location of infection, particularly in the ring finger and thumb, also correlated with MRSA infection. The findings underscore the need for targeted educational campaigns, early intervention protocols for bite wounds, and community engagement to address traditional medicine practices. These measures could improve MRSA management and prevention in similar settings.

Keywords. methicillin-resistant Staphylococcus aureus, hand infections, risk factors, traditional medicine, Philippines

INTRODUCTION

Hand infections are common conditions encountered by orthopedic surgeons, emergency physicians, and primary care providers. Patient demographics, comorbidities, mechanism of injury, and cultural practices influence their severity and outcome.[1,2] Despite extensive global research on hand infections,[3,4] local data in the Philippines remains limited, particularly regarding methicillin-resistant *Staphylococcus aureus* (MRSA).[5]

MRSA infections pose significant treatment challenges, often leading to prolonged hospitalizations, surgical interventions, and increased morbidity.[6,7] Delayed diagnosis and inappropriate management can result in severe complications, including deep tissue infections and even limb amputation.[8] Additionally, traditional medicine use and limited healthcare access may contribute to treatment delays and worse clinical outcomes.[9,10]

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Corresponding author: Tristan Jay I. Arellano, MD
Department of Orthopaedics
Jose B. Lingad Memorial General Hospital
Dolores, San Fernando, Pampanga, 2000 Philippines
E-mail: tristanjay99@gmail.com
ORCiD: https://orcid.org/0009-0004-8140-6914

This study aimed to determine the prevalence of MRSA in hand infections and identify associated factors among patients treated at a public tertiary hospital. Understanding these factors could help improve preventive strategies, treatment protocols, and patient education in similar healthcare settings.[11]

METHODOLOGY

Study design and setting

This was a retrospective, cross-sectional study conducted at Jose B. Lingad Memorial General Hospital (JBLMGH), a public tertiary hospital in Pampanga, Philippines. Data collection covered cases from February 2022 to January 2024.

Study population and sample size

Inclusion criteria

- Patients diagnosed and treated for hand infections at JBLMGH (outpatient or inpatient)

Exclusion criteria

- Patients in extremis
- Non-infected wounds
- Infections not classified as:
  - Bite wounds
  - Paronychia, felon, flexor tenosynovitis, collar button abscess, septic arthritis, osteomyelitis, necrotizing fasciitis, cellulitis, and deep space infections (thenar, hypothenar, dorsal, mid-palmar, Parona's abscess)
- Atypical infections (mycobacterial, viral, fungal)

A total enumeration method was used, including all 233 eligible cases.

Data collection and variables

Patient records were reviewed using a standardized data extraction sheet. Specimens submitted for culture studies included aspirates, tissue samples, or wound discharge obtained during surgical intervention. Wound swabbing was avoided as recommended by our Infectious Disease Service (IDS) and Infection Control Committee (ICC) due to its low microbial yield. Variables collected from patient records were:

- Demographics: Age, gender, handedness, educational attainment
- Employment status and nature of work
- Etiology of hand infection (household, industrial, bite wounds, atraumatic)
- Comorbidities: Diabetes, cardiac disease, renal disease
- Use of traditional medicine before seeking medical consult
- Location of infection
- Infection classification

Statistical analysis

Data were analyzed using OpenEpi. Chi-square and Fisher's exact tests were used for categorical variables. The significance threshold was set at $p < 0.05$.

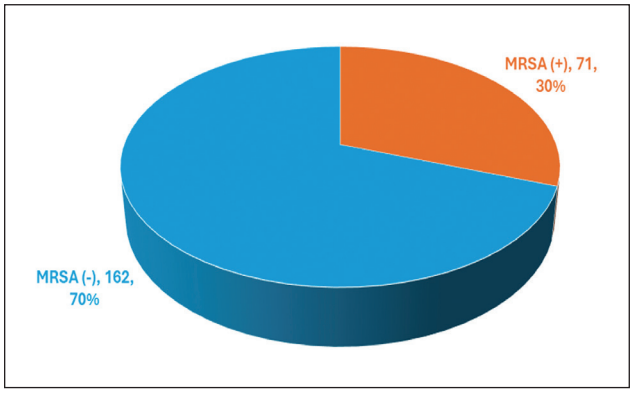

Figure 1. Prevalence of MRSA.

Ethical considerations

The study was approved by the JBLMGH Research Ethics Committee (JBLMGH-REC 2022-42B). Patient data confidentiality was maintained.

RESULT

A total of 233 patients with hand infections, managed as either outpatients or inpatients, were included in this study. Out of this number, 71 patients with MRSA were found, resulting in a MRSA prevalence of 30% (Figure 1).

Age ($p = 0.447$, Fisher's exact test), gender ($p = 0.594$, Chi-square test), and handedness ($p = 0.550$, Chi-square test) were not significantly different between the MRSA (+) and MRSA (-) groups (Table 1). However, education was significantly associated with MRSA status ($p = 0.027$), with a higher percentage of MRSA (+) cases among the unschooled (47%).

Employment status ($p = 0.148$, Chi-square test) had no significant association, with similar MRSA (+) proportions among employed (27%) and unemployed (36%) patients (Table 2). Likewise, the nature of work ($p = 0.124$, Fisher's exact test) did not significantly correlate with MRSA status, with no clear trend across occupations.

MRSA (+) cases were more commonly caused by bite wounds (60%, $p = 0.002$, Chi-square test) compared to household (29%), industrial (24%), and atraumatic infections (20%) (Table 3).

The presence of any comorbidity showed no significant association with MRSA ($p = 0.972$, Chi-square test), as MRSA (+) proportions are similar among patients with (31%) and without (30%) comorbidities (Table 4). Similarly, diabetes, cardiac, and renal conditions did not show a significant link to MRSA ($p = 0.493$).

Among MRSA (+) patients, 41% used traditional medicine before consulting at JBLMGH, compared to 23% who did not (Table 5). The difference is statistically significant ($p = 0.002$, Chi-square test), indicating a strong association.

Table 1. Demographic characteristics of patients with and without MRSA

Variable	MRSA (+) n (%)	MRSA (-) n (%)	Total	*p*-value	
Age (years)					
0-10	7 (27)	19 (73)	26	0.447	F
11-20	15 (35)	28 (65)	43		
21-30	16 (36)	28 (64)	44		
31-40	13 (32.5)	27 (67.5)	40		
41-50	14 (34)	27 (66)	41		
51-60	4 (15)	23 (85)	27		
61-70	2 (17)	10 (83)	12		
Gender					
Male	35 (29)	86 (71)	121	0.594	C
Female	36 (32)	76 (68)	112		
Education					
Unschooled	18 (47)	20 (53)	38	0.027*	C
Elementary	24 (33)	48 (67)	72		
High School	21 (21)	77 (79)	98		
College	8 (32)	17 (68)	25		
Handedness					
Right	51 (32)	110 (68)	161	0.550	C
Left	20 (28)	52 (72)	72		

* Significant at 0.05 level (2-tailed)
C – Chi-square test; F – Fisher's exact test

Table 2. Comparison of immediate and one-year post-operative radiographic parameters

Variable	MRSA (+) n (%)	MRSA (-) n (%)	Total	*p*-value	
Employment status					
Unemployed	33 (36)	59 (64)	92	0.148	C
Employed	38 (27)	103 (73)	141		
Nature of work					
Agriculture	10 (18)	47 (82)	57	0.124	F
Animal Handling	9 (43)	12 (53)	21		
Architecture and Construction	10 (31)	22 (69)	32		
Food Industry	8 (32)	17 (68)	25		
Forestry	1 (50)	1 (50)	2		

C – Chi-square test; F – Fisher's exact test

Table 3. Etiology of hand infection of patients with and without MRSA

Etiology of Infection	MRSA (+) n (%)	MRSA (-) n (%)	Total	*p*-value	
Household	31 (29)	77 (71)	108	0.002**	C
Industrial	20 (24)	65 (76)	85		
Bite wounds	18 (60)	12 (40)	30		
Atraumatic	2 (20)	8 (80)	10		

** Significant at 0.01 level (2-tailed)
C – Chi-square test

Table 4. Comorbidities of patients with and without MRSA

Comorbidities	MRSA (+) n (%)	MRSA (-) n (%)	Total	*p*-value	
With any comorbidity	51 (31)	116 (69)	167	0.972	C
Without any comorbidity	20 (30)	46 (70)	66		
Diabetes	32 (39)	50 (61)	82	0.493	C
Cardiac comorbidities	11 (29)	27 (71)	38		
Renal comorbidities	8 (42)	11 (58)	19		

C – Chi-square test

The results show a significant correlation (p = 0.001, Fisher's exact test), with MRSA (+) cases more common in wounds located on the ring finger and fourth webspace (53%) and the thumb & first webspace (50%) (Table 6).

There was no significant association between type of infection and MRSA (p = 0.297, Fisher's exact test) (Table 7).

DISCUSSION

This study reveals significant insights into the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) among patients with hand infections. The overall prevalence of MRSA in this study was 30%. This aligns with prior studies that reported variable MRSA prevalence rates across different settings, reinforcing the ongoing challenge posed by this resistant organism in healthcare environments.[1,6]

Demographic factors

There was no significant association between MRSA status and age (p = 0.447). This supports prior research indicating that MRSA infections affect various age groups without a clear predilection.[12] Similarly, sex was not significantly associated with MRSA (p = 0.594), consistent with previous reports suggesting that biological sex is not a strong determinant of MRSA infection risk.[2]

However, education level showed a statistically significant association with MRSA status (p = 0.027), where unschooled patients had a higher prevalence of MRSA (47%). This aligns with research suggesting that lower educational attainment may be linked to reduced healthcare access, poor wound care practices, and delayed treatment-seeking behavior.[10,13] Meanwhile, handedness showed no significant correlation with MRSA (p = 0.550), consistent with the literature.[3]

Employment status and nature of work

Employment status did not show a statistically significant association with MRSA (p = 0.148), supporting prior studies that found no clear occupational predilection for MRSA in hand infections.[8] Similarly, the nature of work (p = 0.124) was not significantly associated with MRSA status, suggesting that specific industries such as agriculture, animal handling, or construction do not independently increase MRSA

Table 5. Use of traditional medicine before seeking medical consult among patients with and without MRSA

Traditional medicine use	MRSA (+) n (%)	MRSA (-) n (%)	Total	*p*-value	
Yes	38 (41)	54 (59)	92	0.002**	C
No	33 (23)	108 (77)	141		

** Significant at 0.01 level (2-tailed)
C – Chi-square test

Table 6. Location of infection of patients with and without MRSA

Location of infection	MRSA (+) n (%)	MRSA (-) n (%)	Total	*p*-value	
Thumb and 1st webspace	17 (50)	17 (50)	34	0.001**	F
Index finger and 2nd webspace	11 (27)	30 (73)	41		
Middle finger and 3rd webspace	9 (18)	40 (82)	49		
Ring finger and 4th webspace	18 (53)	16 (47)	34		
Small finger	3 (10)	26 (90)	29		
Palm and dorsal side of hand	11 (31)	25 (69)	36		
Wrist and forearm	0 (0)	1 (100)	1		
Multiple sites	2 (22)	7 (78)	9		

** Significant at 0.01 level (2-tailed)
F – Fisher's exact test

Table 7. Type of infection of patients with and without MRSA

Type of infection	MRSA (+) n (%)	MRSA (-) n (%)	Total	*p*-value	
Cellulitis	4 (36)	7 (64)	11	0.297	F
Tenosynovitis	32 (33)	65 (67)	97		
Deep infection	21 (29)	52 (71)	73		
Necrotizing type	1 (25)	3 (75)	4		
Osteomyelitis	6 (18)	28 (82)	34		
Multiple diagnoses	7 (50)	7 (50)	14		

** Significant at 0.01 level (2-tailed)
F – Fisher's exact test

risk. Prior studies suggested that environmental exposure may contribute to bacterial transmission but is not the sole predictor of MRSA infection.[14]

Etiology of hand infections

Etiology was significantly associated with MRSA (p = 0.002), particularly for bite wounds (60% MRSA-positive). This aligns with research indicating that animal and human bite wounds pose a higher risk for MRSA colonization, given their polymicrobial nature and increased likelihood of deep tissue penetration.[15] Comparatively, infections due to household injuries (29%), industrial trauma (24%), and atraumatic causes (20%) had lower MRSA rates, reinforcing the need for heightened vigilance in bite wound management.

Comorbidities

This study found no significant association between MRSA status and underlying comorbidities (p = 0.972), supporting prior research indicating that comorbidities do not necessarily increase MRSA susceptibility.[9] However, conditions like diabetes have been associated with higher complication rates in MRSA-positive hand infections.[16]

Use of traditional medicine

A statistically significant association was found between traditional medicine use and MRSA positivity (p = 0.002). Patients who utilized traditional remedies before seeking medical consultation had higher MRSA rates, raising concerns about delayed treatment and potential bacterial resistance linked to non-standardized practices.[17]

Location and type of infection

The location of infection was statistically associated with MRSA (p = 0.001), with wounds on the ring finger and thumb being more frequently MRSA-positive. Previous studies suggest that hand infections in high-contact areas (e.g., dominant fingers) may have higher colonization rates due to frequent exposure to contaminated surfaces.[18] The type of infection (p = 0.297) was not significantly associated with MRSA status, indicating that the type of infection alone does not predict MRSA involvement.[3]

CONCLUSION

The study highlights are as follows:

- High prevalence of MRSA: The study found that approximately 3 out of every 10 patients treated for hand infections were positive for MRSA. This high prevalence necessitates the implementation of stringent infection control measures within the hospital to prevent further spread.
- Significant association with education level: The only demographic factor significantly associated with MRSA status was education level, with unschooled individuals showing a higher prevalence (47%). This suggests that educational interventions could be vital in reducing MRSA rates, emphasizing the importance of health literacy in preventing infections.
- Bite wounds as a major risk factor: The etiology of hand infections showed that bite wounds were significantly associated with MRSA (60%). This highlights the need for specific protocols when treating bite wounds, including thorough assessment and potential prophylactic measures against MRSA.
- Traditional medicine use: A significant proportion of MRSA-positive patients reported using traditional medicine before seeking medical care. This indicates a potential delay in appropriate treatment and suggests that healthcare providers should engage with communities to educate them about the risks associated with delaying conventional medical treatment.
- Location of infection: the location of hand infections was significantly associated with MRSA status, particularly in areas such as the ring finger and thumb. This information can guide clinicians in monitoring and managing high-risk areas more effectively.

These findings underscore the necessity for targeted interventions aimed at education and awareness regarding wound care and the risks associated with traditional medicine usage. Some practical implications of the study for JBLMGH are as follows:

- Enhanced infection control protocols: Implement strict infection control measures, including regular screening for MRSA among patients presenting with hand infections. This may involve isolating MRSA-positive patients to prevent cross-contamination.
- Educational campaigns: Develop educational initiatives aimed at improving health literacy among patients, particularly targeting unschooled individuals. These campaigns should focus on proper wound care, recognizing signs of infection, and the importance of seeking timely medical attention.
- Targeted management for bite wounds: Establish specific guidelines for managing bite wounds, including protocols for assessing risk factors for MRSA colonization and infection. This could involve prophylactic antibiotic treatment or referral to specialists when necessary.
- Community engagement: Collaborate with local communities to address the use of traditional medicine. Healthcare providers should work to build trust and demonstrate the importance of seeking conventional medical care promptly.
- Resource allocation for training: Allocate resources toward training healthcare staff on recognizing and managing MRSA cases effectively, focusing on high-risk populations and areas identified in this study.
- Monitoring and evaluation: Regularly monitor infection rates and evaluate the effectiveness of implemented strategies to adapt interventions based on emerging trends or challenges in managing MRSA within the hospital setting.

By addressing these implications, the hospital can enhance its capacity to manage MRSA effectively among patients with hand infections while ensuring patient safety and improving overall healthcare outcomes in a resource-limited environment.

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STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

TJA: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration; **JAG:** Conceptualization, Methodology, Writing – original draft preparation; **MMV:** Conceptualization, Methodology, Validation, Formal analysis, Resources, Data Curation, Writing – original draft preparation, Writing – review and editing, Visualization

AUTHOR DISCLOSURE

The authors declared no conflict of interest.

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The datasets generated and analyzed in this study are included in the published article.

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ORIGINAL ARTICLE

Psychometric Properties of the Filipino Version of Harris Hip Score Among Patients with Osteoarthritis and Hip Fractures: A Cross-Cultural Validation Study

Diovince S. Tan, MD, Byron S. Angeles, MD, FPOA, Carmelo L. Braganza, MD, FPOA, Carlo F. Fernandez, MD, DPBO

Department of Orthopaedics, University of Santo Tomas Hospital, España, Manila, Philippines

ABSTRACT

Background. The Harris Hip Score (HHS) is a widely used instrument for assessing hip function and quality of life in patients with hip conditions. However, the questionnaire has not been validated in Filipino, limiting its use in the Philippines. This study aimed to translate, culturally adapt, and validate the HHS for Filipino-speaking patients with osteoarthritis or hip fractures to enhance its clinical and research applicability.

Methodology. This cross-sectional, cross-cultural validation study followed established protocols, including forward and backward translation, expert panel review, pretesting, and field testing. A total of 120 bilingual Filipino patients (20 for pretesting and 100 for field testing) with osteoarthritis or hip fractures participated. Psychometric evaluations assessed content validity (S-CVI/Average ≥0.90), internal consistency (Cronbach's alpha), test-retest reliability (Intraclass Correlation Coefficient, ICC), and construct validity through correlations with the WOMAC and SF-36 scores.

Results. The Filipino version of the HHS demonstrated strong psychometric properties. Internal consistency was acceptable (Cronbach's alpha = 0.724), while test-retest reliability was excellent (ICC = 0.921, p <0.001). Content validity was robust, with an S-CVI of 0.963. Construct validity was confirmed through significant correlations with WOMAC and SF-36 domains, supporting both convergent and discriminant validity. Pretesting revealed that the translated questionnaire was culturally relevant, easily understood, and applicable to the target population. Field testing further validated its reliability and clinical usability.

Conclusion. The Filipino version of the Harris Hip Score is a valid and reliable instrument for evaluating hip function and quality of life in Filipino-speaking patients with osteoarthritis or hip fractures. It offers clinicians and researchers a more culturally accessible tool for Filipino-speaking patients to assess treatment outcomes. Future studies should explore its responsiveness over time and evaluate its applicability to a broader range of populations.

Keywords. Harris Hip Score, Filipino version, osteoarthritis, hip fractures, validation, reliability, quality of life, translation, cross-cultural adaptation

INTRODUCTION

Osteoarthritis (OA), also known as degenerative joint disease, is the most prevalent chronic rheumatic condition and a leading cause of pain and disability worldwide.[1] It primarily affects the hips and knees.[2] In the Philippines, 6–11% of individuals aged 60 and above are diagnosed with OA, a figure projected to double within 25 years.[1]

Total hip arthroplasty (THA) is the standard surgical intervention for patients experiencing intractable pain, severe functional impairment, or failure of nonsurgical treatments. Globally, approximately one million THA procedures are performed annually for advanced hip OA.

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Corresponding author: Diovince S. Tan, MD
Department of Orthopaedics,
University of Santo Tomas Hospital,
España, Manila, Philippines
E-mail: diovince_tan10@yahoo.com
ORCiD: https://orcid.org/0009-0007-8112-1208

Various outcome measures have been developed to assess hip pathologies, including the Oxford Hip Score, Nonarthritic Hip Score, Hip and Groin Outcome Score, International Hip Outcome Tool, Hip Outcome Score, and Merle d'Aubigné and Postel score.[3]

Among these, the Harris Hip Score (HHS) is one of the oldest and most widely used.[3] According to Malchau et al., the HHS is a reliable and valid measure of hip function, with numerous studies utilizing it as a self-reported patient questionnaire.

Both the original and modified versions have been applied in recent studies on various hip pathologies, including ligamentum and labral tears, infected hip arthroplasty revisions, and hip fractures.[4]

However, a culturally adapted and validated Filipino version of the HHS has not yet been developed. Cross-cultural equivalence should be standardized to validate assessment tools. This study aimed to develop a reliable and valid Filipino version of the HHS, adapting it to the local culture following Guillemin et al.'s guidelines.[4] Given that osteoarthritis and hip fractures are the most common hip conditions at the University of Santo Tomas Hospital, these were selected for validation to ensure consistency. Expanding the scope to other hip disorders could introduce variability, potentially affecting psychometric evaluation. This focused approach provides a solid foundation for future validation in other hip pathologies.

Based on the psychometric properties of the HHS and existing validation protocols, the authors also used the Western Ontario and McMaster Osteoarthritis Index (WOMAC) and the Short Form Health Survey (SF-36) for reference.

OBJECTIVES

General objective

This study aimed to determine the psychometric properties of the Filipino version of the Harris Hip Score (HHS) among patients with osteoarthritis or hip fractures.

Specific objectives

1. To translate and adapt the Harris Hip Score (HHS) into the Filipino language
2. To determine the content equivalence of the English and Filipino versions of the HHS
3. To determine the linguistic equivalence of the English and Filipino versions of the HHS
4. To determine the conceptual equivalence of the English and Filipino versions of the HHS
5. To determine convergent and discriminant validities of the Filipino versions of the HHS with WOMAC and SF-36 questionnaires
6. To determine the reliability, in terms of test-retest reliability and internal consistency, of the Filipino version of the HHS

METHODOLOGY

Study design

This study was a cross-sectional, cross-cultural validation study following the steps outlined by Beaton et al.,[5] and Polit and Yang.[6] The design aimed to assess the adequacy and equivalence of a translated, culturally adapted questionnaire in comparison to the original version. It consisted of five steps: forward translation, back-translation, panel reconciliation of the translated tools, pretesting of the prefinal translated tools, and field testing of the final tool.

Subject selection criteria

The target population of the study were adult Filipino bilingual patients who had completed at least secondary education, had osteoarthritis and/or hip fractures, and were seen in the UST Hospital from September 2023 to November 2024.

Inclusion criteria

1. Adult patients with hip osteoarthritis and/or hip fractures seen in the USTH (private and clinical division) from September 2023 to November 2024
2. Fluent in both English and Filipino

Exclusion criteria

1. Patients who could not comprehend the questionnaires due to cognitive impairment

Withdrawal criteria

1. Patients who requested to withdraw from the study
2. Patients who requested to transfer to a different institution or deferred continuity of care

Sampling technique

The study used purposive sampling and included participants who met the above-mentioned eligibility criteria. The concept of power does not apply in scale development or validation studies hence, the rule of thumb for these study designs was used. The rule of thumb is to include two to three participants per item for the pre-testing of the questionnaires and to recruit at least five to 10 participants per item for the final, field testing.[6] Since the HHS had 10 items, at least 20 participants were necessary for the pretesting and at least 50 to 100 participants were needed for the field testing. Hence, this study recruited a minimum of 70 participants; 20 in the pretesting phase and at least 50 in the field-testing phase.

The study utilized a known-groups approach, which doubles the sample size for field testing with a 1:1 group ratio. Hence, this study recruited a minimum of 120 participants, 20 in the pretesting phase (all with osteoarthritis and/or hip fracture) and at least 100 in the field-testing phase (50 with and 50 without osteoarthritis and/or hip fracture).

Step 1: Forward translation

This entailed translating the items, response options, and instructions from the source language (English) to the target language (Filipino). In this study, a decentered or symmetric translation was employed, meaning that some words or phrases were adjusted to ensure contextual relevance and applicability in the Philippine setting. As suggested by Beaton et al. (2000), forward translation was carried out by two independent translators who were native Filipino speakers, professional Filipino teachers, and fluent in English. The translators worked separately, and once completed, their comments and recommendations were reviewed and discussed in close coordination with the investigators.

Step 2: Back-translation

The reconciled Filipino version of the HHS then underwent back-translation into English to ensure that the meanings of the original were accurately retained (semantic equivalence). This step was carried out by two native English speakers who were unaware of the original English versions.

Step 3: Panel reconciliation

A consensus meeting was held with the translators to resolve any discrepancies during the forward and back translation processes.

Step 4: Pretesting of pre-final tool

This step ascertained the content validity of and pre-tested the pre-final Filipino HHS. The Filipino HHS was distributed to at least three content experts in Internal Medicine, Rheumatology, and Orthopaedics. These content experts assessed the content and cultural relevance of the translated items using a 4-point ordinal scale, with 1 being "not relevant" and 4 being "highly relevant." Items with an I-CVI ≥0.78 were retained, and the S-CVI/Average was estimated by computing the average I-CVI. An S-CVI/Average ≥0.90 was considered adequate.[7]

In the pretesting phase, 20 separate, eligible participants answered the prefinal Filipino HSS and were briefly interviewed to identify areas which needed improvement, using the following questions:

a. From your understanding, what do these questions mean? [*Sa iyong pagkakaunawa, ano ang ibig sabihin/kahulugan ng mga tanong na ito?*]
b. Were these questions easy or hard to answer? [*Mahirap ba o madali lang sagutin ang mga tanong na ito?*]
c. Did these questions make you uncomfortable, offended, or disturbed in any way? If yes, which ones did? [*Sa mga tanong na ito, mayroon bang nakababagabag, nakakabastos, o hindi ka kumportableng sagutan? Kung mayroon, alin ang mga ito?*]
d. Were there questions that were unclear or confusing? If yes, which ones? [*May mga tanong ba na malabo o nakakalito? Kung mayroon, alin ang mga ito?*]

Step 5: Field testing of final tool

The finalized Filipino and English versions of the HHS, arranged in varying item orders, were distributed to at least 50 bilingual participants fluent in both English and Filipino. These participants also received the validated WOMAC and SF-36 questionnaires to complete, a process that took 20 to 25 minutes. The investigators obtained the participants' consent to review their medical records and extract relevant data, such as physical exam results and laboratory findings.

During the participants' medical follow-up after one week, they were asked to complete the Filipino and English versions of the HHS again.

Ethical considerations

The first three phases of the research process—forward translation, back translation, and panel reconciliation—were performed while waiting for ethical approval as these did not involve eligible participants. Once approval ethical approval from the UST Hospital Research Ethics Committee (USTH REC) was granted, the investigators proceeded with the fourth phase, pretesting.

Data analysis

Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were reported as percentages (%). The minimum and maximum scores for individual items and the total HHS-F score were assessed to identify potential floor or ceiling effects. Statistical analysis was conducted using SPSS software (version 30, SPSS Inc., Chicago, IL, USA), with significance set at $p < 0.05$.

Internal consistency was evaluated using Cronbach's alpha (α), which estimates the reliability of a scale based on a single administration. Cronbach's α was also recalculated after systematically removing one item from the 12 questions to assess its impact. Additionally, all items were analyzed for their correlation with the overall score.[5,8-10]

The intraclass correlation coefficient (ICC) was also used to evaluate reliability. Among the various forms of ICC, a two-way random effects model for single-measure reliability analysis was utilized in this study. ICC values, along with confidence intervals, were calculated for each item and the total score. The difference in mean scores between the test and retest was computed, and a paired t-test was used to identify any systematic differences. Reproducibility was analyzed by determining the correlation between the test and retest results using Spearman's correlation coefficient.[5,8-10]

In this study, validity was assessed by calculating Spearman's correlation coefficient between the HHS-F and the WOMAC, as well as the SF-36. To determine convergent validity, Spearman's correlation coefficients were calculated between the HHS-F and the WOMAC scores, along with related subscores of the SF-36. Discriminant validity was evaluated

Table 1. Content validity among experts (HHS-F)

Item	Relevant ratings (ratings=3)	Not relevant ratings (ratings=2)	I-CVI	Decision	S-CVI
Section 1					1.00
Item 1	3	0	1.00	Retain	
Item 2	3	0	1.00	Retain	
Item 3	3	0	1.00	Retain	
Item 4	3	0	1.00	Retain	
Item 5	3	0	1.00	Retain	
Item 6	3	0	1.00	Retain	
Item 7	3	0	1.00	Retain	
Item 8	3	0	1.00	Retain	
Section 2					0.89
Item 1	2	1	0.78	Retain	
Item 2	3	0	1.00	Retain	
Item 3	3	0	1.00	Retain	
Item 4	2	1	0.78	Retain	
Overall S-CV I					0.963

by calculating Spearman's correlation coefficients between the HHS-F and the mental component summary, mental health, and general health subscores of the SF-36. Higher correlation coefficients were anticipated for convergent validity, while lower coefficients were expected for discriminant validity.[5,8-10]

RESULTS

We present here the content, convergent, and discriminant validity of the Filipino version of the Harris Hip Score (HHS-F).

Pre-testing of pre-final tool

The Filipino version of the Harris Hip Score (HHS-F) demonstrated strong content validity based on expert assessments. In Section 1, all eight items received perfect relevance ratings (I-CVI = 1.00; S-CVI = 1.00), requiring no revisions. In Section 2, Items 1 and 4 met the minimum I-CVI threshold (0.78), while Items 2 and 3 achieved perfect scores (I-CVI = 1.00), resulting in an S-CVI of 0.89, which was acceptable. The overall S-CVI of the instrument was 0.963, exceeding the 0.90 standard, confirming its validity and suitability for pretesting (Table 1).

From your understanding, what do these questions mean? [Sa iyong pagkakaunawa, ano ang ibig sabihin/ kahulugan ng mga tanong na ito?]

Theme 1: Health experience and general well-being

Participants responded that the questions were primarily focused on the individual's health experience and general well-being. They said that the questions explored their overall health situation, how they perceived their condition, and its impact on their quality of life. Many felt the questions were asking about how their health influenced their daily existence and general living conditions. This theme represents how the condition affects the person's emotional, psychological, and overall well-being, giving a broader view of their health experience (Table 2).

Theme 2: Physical condition and mobility

Another significant theme that emerged was the focus on the individual's physical condition and mobility. Respondents understood the questions as inquiring about their ability to move, the difficulties they face in physical activities, and the limitations imposed by their health condition. There was an emphasis on concerns regarding mobility, joint conditions, and how physical challenges impacted their ability to perform tasks. This theme highlighted how health conditions directly affect an individual's movement and physical functionality (Table 3).

Table 2. Responses relating to Theme 1: Health experience and general well-being

Respondent Number	Response
#1	These questions are about my health experience.
#3	These questions refer to my quality of life related to health.
#8	They are about my general health situation.
#10	The questions are about how I feel the condition impacts my life.
#11	The questions explore how my health affects my living.

Table 3. Responses relating to Theme 2: Physical condition and mobility

Respondent Number	Response
#2	The questions are asking about my physical condition.
#6	These questions are about my experience with movement and health.
#12	The questions are about how hard or easy it is for me to move.
#13	The questions refer to my mobility and quality of life.
#15	These are about my physical activity limitations.
#16	The questions examine my joint condition.
#20	The questions ask about my ability to move properly.

Theme 3: Daily life and activities
The third theme was how their health affects daily life and activities. Many responses noted that the questions were aimed at understanding how the condition interferes with their ability to carry out routine tasks and responsibilities. This theme reflects how individuals perceive the impact of their condition on daily activities such as chores, work, and social interactions. Respondents felt the questions were assessing the functional limitations they experience due to their health condition (Table 4).

Were these questions easy or hard to answer? [Mahirap ba o madali lang sagutin ang mga tanong na ito?]

Theme 1: Easy to answer (straightforward and simple)
The questions were easy to answer, straightforward, simple, clear, and understandable. Respondents found the questions easy because they were based on personal experience or because they were simple and direct, requiring little effort to understand or answer (Table 5).

Theme 2: Some difficulty (requires thought or reflection)
A few respondents said that some questions required more thought or reflection, particularly those with technical terms or more complex phrasing. These respondents found certain questions tricky to understand. While most of the questions were easy, some presented challenges that required deeper consideration or clarification (Table 6).

Theme 3: Personal and relatable (easy due to personal experience)
Some respondents highlighted that the questions were easy because they were personal and relatable, directly connecting to their own experiences and daily life. These individuals felt that the questions were easier to answer because they were grounded in their personal health experiences, making it easier to provide relevant responses (Table 7).

Did these questions make you uncomfortable, offended, or disturbed in any way? If yes, which ones did? [Sa mga tanong na ito, mayroon bang naka-babagabag, nakakabastos, o hindi ka kumportableng sagutan? Kung mayroon, alin ang mga ito?]

Theme 1: No discomfort or offense
Most respondents did not feel uncomfortable, offended, or disturbed by the questions. They felt comfortable answering all the questions and found that none of the questions were offensive or troubling. They mentioned that there was no discomfort or offense experienced during the process, indicating a positive experience with the questions (Table 8).

Theme 2: Slight personal or sensitive questions
A few respondents noted that some questions felt slightly personal or sensitive, but not offensive. While they felt that certain questions touched on more intimate aspects of their experience, they did not feel disturbed or offended by them. Despite mild sensitivity to certain topics, they still felt comfortable answering the questions overall (Table 9).

Table 4. Responses relating to Theme 3: Daily life and activities

Respondent Number	Response
#4	They ask how my condition affects my daily life.
#5	These questions are about the things I can do daily.
#7	The questions are meant to know how my condition affects me.
#9	These questions are about my ability to do everyday tasks.
#14	They ask about how my condition affects my abilities.
#17	The questions are about how I handle daily activities.
#19	These are about how my illness affects my daily tasks.

Table 5. Responses relating to Theme 1: Easy to answer (straightforward and simple)

Respondent Number	Response
#4	They were easy to answer because they are simple.
#9	Easy because they are based on my experience.
#3	They were straightforward to answer.
#7	Simple to answer.
#2	Easy to answer.
#12	Easy, especially with relevant experience.
#5	They were simple to answer.
#8	Easy to answer.
#15	Straightforward to answer.
#6	Simple to answer.
#19	They were easy to answer.
#10	Easy overall, but a few needed reflection.

Table 6. Responses relating to Theme 2: Some difficulty (requires thought or reflection)

Respondent Number	Response
#13	A bit easy, but some required a little thought.
#17	Some questions were easy, but others were hard due to technical terms.
#11	Easy, but one was a bit tricky to understand.
#16	Some were easy, and some were challenging.
#14	Some questions were a bit challenging.
#18	Easy overall, but a few needed reflection.

Table 7. Responses relating to Theme 3: Personal and relatable (easy due to personal experience)

Respondent Number	Response
#9	Easy to answer because they are based on my experience.
#20	Easy since they are personal.
#12	Easy to answer, especially with relevant experience.

Theme 3: General comfort but no specific comments
Some respondents expressed that they did not have any specific discomfort or concerns but did not elaborate further. These respondents indicated that, in general, they found the questions acceptable and easy to answer, but they did not provide detailed feedback on the nature of the questions. This theme reflects a general sense of comfort without any

specific comments on the questions' content or emotional impact (Table 10).

Were there questions that were unclear or confusing? If yes, which ones? [May mga tanong ba na malabo o nakakalito? Kung mayroon, alin ang mga ito?]

Theme 1: All questions were clear and understandable
Most respondents found the questions easy to answer, clear, simple, and straightforward. They found them easy to understand without significant challenges. This theme reflects a high level of clarity and simplicity in the questions, as the respondents felt comfortable providing answers without much thought or effort (Table 11).

Theme 2: A few questions were slightly confusing or unclear
A few respondents noted that some questions were slightly challenging to answer, either because they contained technical terms or required more reflection. These respondents felt that while most questions were manageable, a few required more thought or posed mild difficulty in comprehension. This theme highlights the presence of minor challenges within an otherwise clear set of questions, indicating that some areas could have been made clearer or simpler (Table 12).

Theme 3: No specific comments, general clarity
Some respondents did not provide specific comments but generally agreed that the questions were easy to answer. They acknowledged that, overall, the questions were simple, though a few may have required some thought. This theme reflects a sense of comfort with answering the questions, where most respondents found them manageable but did not elaborate on particular difficulties. It suggests that even when challenges arose, they were not significant enough to cause discomfort (Table 13).

The expert evaluations of the Filipino Harris Hip Score (HHS) highlight the strong relevance of items related to pain, stiffness, and physical function in assessing hip function (Table 14). Most (75%) experts rated the pain item as highly relevant (HR), with the remaining 25% rating it as quite relevant (QR). Morning stiffness was rated HR by 65% and QR by 35%. Physical function items, such as descending stairs, received the highest agreement, with 90% of experts rating it HR. Other functional activities, like rising from sitting and

Table 8. Responses relating to Theme 1: No discomfort or offense

Respondent Number	Response
#3	No, none of the questions were offensive.
#5	I felt comfortable answering them.
#6	I wasn't offended by any question.
#7	Nothing was offensive or troubling.
#9	I didn't feel uncomfortable answering.
#10	No discomfort was felt.
#11	I didn't find anything offensive or disturbing.
#13	No discomfort or offense.
#14	There was no question that offended me.
#15	I didn't feel any discomfort.
#16	Nothing caused discomfort.
#17	No discomfort in answering.
#18	I was fine with all the questions.
#19	There wasn't anything offensive.
#20	Nothing made me feel uncomfortable.
#2	No, all questions were fine for me.

Table 9. Responses relating to Theme 2: Slight personal or sensitive questions

Respondent Number	Response
#8	One question felt slightly personal, but not offensive.
#12	One question was slightly sensitive for me.

Table 10. Responses relating to Theme 3: General comfort but no specific comments

Respondent Number	Response
#1	No discomfort in answering.
#4	I wasn't offended by any question.

Table 11. Responses relating to Theme 1: All questions were clear and understandable

Respondent Number	Response
#1	All questions were clear.
#2	None of the questions were confusing.
#3	I understood all the questions.
#4	Everything was clear to me.
#5	None were unclear.
#6	No question was confusing.
#7	All questions were understandable.
#8	Everything was clear and understandable.
#9	I found all the questions clear.
#10	Everything was straightforward.
#11	All questions were clear to me.
#12	None of the questions were confusing.
#13	There were no unclear questions.
#14	I didn't find any question confusing.
#15	Every question was clear.

Table 12. Responses relating to Theme 2: A few questions were slightly confusing or unclear

Respondent Number	Response
#16	One or two questions were a bit unclear.
#17	One question was slightly confusing.
#18	One question wasn't clear at first.
#19	One question was hard to understand at first.

Table 13. Responses relating to Theme 3: No specific comments, general clarity

Respondent Number	Response
#20	None of the questions were unclear.

standing, also received high HR ratings. Mobility tasks, such as bending, walking, and self-care activities, were similarly deemed highly relevant. Items related to domestic duties, both light and heavy, were also seen as essential for evaluating broader functional capacity.

Pain-related items were largely rated as manageable, with only 5% of participants reporting difficulty, suggesting that pain is not a significant barrier to daily activities for most (Table 15). While tasks like walking, stair navigation, and weight-bearing were also considered manageable, stiffness, particularly morning stiffness, was identified as a concern by 45% of participants. Physical function items, including ascending stairs, bending, and daily activities such as getting in and out of cars or beds, were predominantly rated as manageable. Domestic duties, both heavy and light, were also perceived as undemanding by most.

Table 16 shows participants' ratings on the significance of various health and physical function aspects. Pain management was prioritized by many, with items like pain, walking, and stair navigation considered essential. While nocturnal pain was noted as significant for some, stiffness, especially morning stiffness, emerged as a major concern. Physical function items, such as ascending stairs, rising from sitting, and daily tasks like bending and walking, were rated as crucial for maintaining independence. Self-care activities, such as putting on socks and rising from bed, were also highlighted as important.

The Filipino version of the Harris Hip Score (HHS-F) demonstrated strong reliability, with excellent test-retest reliability (ICC = 0.921) and a statistically significant *p*-value (<0.001), ensuring stable measurements (Tables 17 and 18). The internal consistency, measured by Cronbach's alpha at 0.724, confirmed that the HHS-F reliably assessed hip function and health-related quality of life.

Table 19 further analyzed the relevance of items in the SF-36 questionnaire across various health domains. The General Health domain was rated as highly relevant (HR)

Table 16. Frequency and percentage of item importance according to participants (HHS-F)

Items	Frequency (%)	
	Yes	No
Seksyon 1		
Sakit ___ Wala, o binabalewala ito ___ Bahagyang, paminsan-minsan, walang kompromiso sa aktibidad ___ Ang banayad na pananakit, walang epekto sa karaniwang mga aktibidad, bihirang katamtamang pananakit na may hindi pangkaraniwang aktibidad, ay maaaring uminom ng aspirin ___ Katamtamang sakit, matitiis ngunit nagbibigay ng konsesyon sa sakit. Ilang limitasyon ng ordinaryong aktibidad o trabaho. Maaaring mangailangan ng paminsan-minsang gamot sapananakit namas malakas kaysa sa aspirin ___ Nararamdaman ang sakit, malubhang limitasyon ng mga aktibidad ___ Ganap na may kapansanan, baldado, sakit sa kama, nakaratay	20 (100%)	0 (0%)
Suporta ___ Wala ___ Tungkod/tungkod para sa mahabang paglalakad ___ Tungkod/tungkod sa karamihan ng oras ___ Isang saklay ___ Dalawang Tungkod/Tungkod ___ Dalawang saklay o hindi makalakad	19 (95%)	1 (5%)
Layo ng nilakad ___ Walang limitasyon ___ Anim na bloke (30 minuto) ___ Dalawa o tatlong bloke (10-15 minuto) ___ Sa loob lamang ng bahay ___ Kama at upuan lang	18 (90%)	2 (10%)
Limp ___ Wala ___ Bahagya ___ Katamtaman ___ Malubha o hindi makalakad	14 (70%)	6 (30%)
Mga aktibidad, sapatos, medyas ___ Madali ___ Medyo nahihirapan ___ Hindi makatali o makakasya	15 (75%)	5 (25%)
Hagdan ___ Karaniwan nang hindi gumagamit ng rehas ___ Karaniwang gumagamit ng rehas ___ Sa anumang paraan ___ Hindi marunong maghagdan	18 (90%)	2 (10%)
Pampublikong transportasyon ___ Makakagamit ng transportasyon (bus) ___ Hindi makakagamit o makakasakay Ng pampublikong transportasyon (bus)	18 (90%)	2 (10%)
Pag-upo ___ Oo ___ Mas mababa sa 10 degrees ng fixed int rotation sa extension ___ Hindi ___ Ang pagkakaiba sa haba ng paa ay mas mababa sa 3.2 cm (1.5 pulgada)	20 (100%)	0 (0%)

Table 16. Frequency and percentage of item importance according to participants (HHS-F) *(continued)*

Items	Frequency (%)	
	Yes	No
Seksyon 2 – Paggalaw		
Kabuuang antas ng Pagbaluktot ___ Wala ___ 0 > 8 ___ 8 > 16 ___ 16 > 24 ___ 24 > 32 ___ 32 > 40 ___ 40 > 45 ___ 45 > 55 ___ 55 > 65 ___ 65 > 70 ___ 70 > 75 ___ 75 > 80 ___ 80 > 90 ___ 90 > 100 ___ 100 > 110	15 (75%)	5 (25%)
Kabuuang Antas ng Abduksyon ___ Wala ___ 0 > 5 ___ 5 > 10 ___ 10 > 15 ___ 15 > 20	14 (70%)	6 (30%)
Kabuuang Antas ng Panlabas na Pag-ikot ___ Wala ___ 0 > 5 ___ 5 > 10 ___ 10 > 1	15 (75%)	5 (25%)
Kabuuang Antas ng Adduction ___ Wala ___ 0 > 5 ___ 5 > 10 ___ 10 > 1	15 (75%)	5 (25%)

Table 17. Test-retest reliability of translated questionnaire (HHS-F)

	ICC	Interpretation	*p*-value
Harris Hip Score – Filipino	0.921	Excellent	<0.001

Table 18. Internal Consistency (HHS-F)

	Cronbach's alpha	Interpretation
Harris Hip Score – Filipino	0.724	Acceptable

Table 19. Frequency and percentage of item relevance per item (SF-36)

Items	Frequency (%)			
	HR	QR	SM	NR
General Health				
1. In general, would you say your health.	20 (100%)	0 (0%)	0 (0%)	0 (0%)
2. Compared to one year ago, how would you rate your health in general now?	20 (100%)	0 (0%)	0 (0%)	0 (0%)
Limitations of Activities				
1. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	18 (90%)	10 (10%)	0 (0%)	0 (0%)
2. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	18 (90%)	10 (10%)	0 (0%)	0 (0%)
3. Lifting or carrying groceries	16 (80%)	4 (20%)	0 (0%)	0 (0%)
4. Climbing several flights of stairs	18 (90%)	10 (10%)	0 (0%)	0 (0%)
5. Climbing one flight of stairs	19 (95%)	1 (5%)	0 (0%)	0 (0%)
6. Bending, kneeling, or stooping	19 (95%)	1 (5%)	0 (0%)	0 (0%)
7. Walking more than a mile	12 (60%)	8 (40%)	0 (0%)	0 (0%)
8. Walking several blocks	18 (90%)	10 (10%)	0 (0%)	0 (0%)
9. Walking one block	19 (95%)	1 (5%)	0 (0%)	0 (0%)
10. Bathing or dressing yourself	16 (80%)	4 (20%)	0 (0%)	0 (0%)
Physical Health Problems				
1. Cut down the amount of time you spent on work or other activities	15 (75%)	5 (25%)	0 (0%)	0 (0%)
2. Accomplished less than you would like	14 (70%)	6 (30%)	0 (0%)	0 (0%)
3. Were limited in the kind of work or other activities	15 (75%)	5 (25%)	0 (0%)	0 (0%)
4. Had difficulty performing the work or other activities (for example, it took extra effort)	18 (90%)	10 (10%)	0 (0%)	0 (0%)

Table 19. Frequency and percentage of item relevance per item (SF-36) *(continued)*

Items	Frequency (%)			
	HR	QR	SM	NR
Emotional Health Problems				
1. Cut down the amount of time you spent on work or other activities	13 (65%)	7 (35%)	0 (0%)	0 (0%)
2. Accomplished less than you would like	15 (75%)	5 (25%)	0 (0%)	0 (0%)
3. Didn't do work or other activities as carefully as usual	13 (65%)	7 (35%)	0 (0%)	0 (0%)
Social Activities				
1. Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?	13 (65%)	7 (35%)	0 (0%)	0 (0%)
Pain				
1. How much bodily pain have you had during the past 4 weeks?	18 (90%)	10 (10%)	0 (0%)	0 (0%)
2. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	18 (90%)	10 (10%)	0 (0%)	0 (0%)
Energy and Emotions				
1. Did you feel full of pep?	15 (75%)	5 (25%)	0 (0%)	0 (0%)
2. Have you been a very nervous person?	13 (65%)	7 (35%)	0 (0%)	0 (0%)
3. Have you felt so down in the dumps that nothing could cheer you up?	13 (65%)	7 (35%)	0 (0%)	0 (0%)
4. Have you felt calm and peaceful?	13 (65%)	7 (35%)	0 (0%)	0 (0%)
5. Did you have a lot of energy?	13 (65%)	7 (35%)	0 (0%)	0 (0%)

Legend: HR – Highly Relevant; QR – Quite Relevant; SR – Somewhat Relevant; NR – Not Relevant

by all participants, while Limitations of Activities, including walking and climbing stairs, were also rated highly relevant. While walking more than a mile had a lower HR rating of 60%, Physical Health Problems items were largely considered highly relevant (75%–90%). Emotional Health Problems and Social Activities received slightly lower HR ratings. The Pain domain was rated as highly relevant by 90% of participants, emphasizing its impact on daily life. The Energy and Emotions section had moderate HR ratings (65%–75%).

The SF-36 survey results indicated that most respondents reported good overall health and limited physical limitations, while a significant proportion experienced emotional problems and pain, impacting their social activities and energy levels (Table 20).

Table 21 provided a comprehensive overview of participants' perceptions regarding their health. While most reported good overall health, emotional problems, and pain were noted as key concerns affecting social interactions and daily functioning.

The SF-36 survey showed a Cronbach's alpha value of 0.741, which falls within the acceptable range for psychological and health-related assessments (Table 22). This value indicated that the SF-36 items were sufficiently correlated, ensuring reliability in measuring health status and quality of life.

Pain, stiffness, and physical function were critical concerns for participants (Table 23). Pain was rated as highly relevant by 75%, while stiffness was viewed as highly relevant by 65%. Physical function was the most critical concern, with 90% rating it highly relevant, reflecting the challenges in performing essential tasks.

There was a mixed landscape of difficulties related to pain, stiffness, and physical function (Table 24). While pain was manageable for most (5% reported difficulty), stiffness and physical function emerged as more significant concerns, with 45% experiencing challenges in mobility and daily tasks such as climbing stairs and rising from a sitting position.

Walking difficulties were most pronounced, with 80% of participants reporting issues in mobility and weight-bearing activities (Table 25). Stiffness affected 45% of participants, while 60% reported difficulties with physical functions such as navigating stairs and performing routine tasks.

The WOMAC questionnaire resulted in Cronbach's alpha value of 0.704, indicating an acceptable level of reliability for assessing health-related quality of life (Table 26).

HHS-F had a Spearman rho of 0.359 when correlated with the WOMAC ($p = 0.010$), indicating a moderate relationship (Table 27). A stronger correlation was found between the HHS-F and the SF-36 (rho = 0.665, $p < 0.01$), reinforcing the validity of both measures in assessing health status and quality of life.

Table 28 evaluated discriminant validity, showing a Spearman rho of 0.880 ($p = 0.022$) between the HHS-F and the General Health domain of SF-36, further confirming the reliability of the HHS-F in capturing aspects of general health.

Field testing of final tool

Most items in the Filipino-translated Harris Hip Score (HHS) were rated as highly relevant, with ratings ranging from 83% to 92% (Table 29). The highest relevance was observed in activity limitations, walking distance, and public transportation, while pain and limp also received strong relevance ratings. Motion-related items, including flexion, abduction, external rotation and adduction, were rated above 87%.

Table 20. Frequency and percentage of item difficulty (SF-36)

Items	Frequency (%)	
	Yes	No
General Health		
1. In general, would you say your health.	0 (0%)	20 (100%)
2. Compared to one year ago, how would you rate your health in general now?	0 (0%)	20 (100%)
Limitations of Activities		
1. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	8 (40%)	12 (60%)
2. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	3 (15%)	17 (85%)
3. Lifting or carrying groceries	0 (100%)	20 (20%)
4. Climbing several flights of stairs	3 (15%)	17 (85%)
5. Climbing one flight of stairs	3 (15%)	17 (85%)
6. Bending, kneeling, or stooping	0 (100%)	20 (20%)
7. Walking more than a mile	2 (10%)	18 (90%)
8. Walking several blocks	0 (100%)	20 (20%)
9. Walking one block	0 (100%)	20 (20%)
10. Bathing or dressing yourself	0 (100%)	20 (20%)
Physical Health Problems		
1. Cut down the amount of time you spent on work or other activities	6 (30%)	14 (70%)
2. Accomplished less than you would like	2 (10%)	18 (90%)
3. Were limited in the kind of work or other activities	2 (10%)	18 (90%)
4. Had difficulty performing the work or other activities (for example, it took extra effort)	1 (5%)	19 (95%)
Emotional Health Problems		
1. Cut down the amount of time you spent on work or other activities	1 (5%)	19 (95%)
2. Accomplished less than you would like	1 (5%)	19 (95%)
3. Didn't do work or other activities as carefully as usual	2 (10%)	18 (90%)
Social Activities		
1. Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?	5 (25%)	15 (75%)
Pain		
1. How much bodily pain have you had during the past 4 weeks?	2 (10%)	18 (90%)
2. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	4 (20%)	16 (80%)
Energy and Emotions		
1. Did you feel full of pep?	3 (15%)	17 (85%)
2. Have you been a very nervous person?	1 (5%)	19 (95%)
3. Have you felt so down in the dumps that nothing could cheer you up?	6 (30%)	14 (70%)
4. Have you felt calm and peaceful?	2 (10%)	18 (90%)
5. Did you have a lot of energy?	2 (10%)	18 (90%)

Table 21. Frequency and percentage of item importance (SF-36)

Items	Frequency (%)	
	Yes	No
General Health		
1. In general, would you say your health.	20 (100%)	20 (0%)
2. Compared to one year ago, how would you rate your health in general now?	20 (100%)	20 (0%)
Limitations of Activities		
1. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	13 (65%)	7 (35%)
2. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	17 (85%)	3 (15%)
3. Lifting or carrying groceries	15 (75%)	5 (25%)
4. Climbing several flights of stairs	19 (95%)	1 (5%)
5. Climbing one flight of stairs	10 (50%)	10 (50%)
6. Bending, kneeling, or stooping	20 (100%)	0 (0%)
7. Walking more than a mile	10 (50%)	10 (50%)
8. Walking several blocks	20 (20%)	0 (100%)
9. Walking one block	20 (20%)	0 (100%)
10. Bathing or dressing yourself	20 (20%)	0 (100%)

Table 21. Frequency and percentage of item importance (SF-36) *(continued)*

Items	Frequency (%)	
	Yes	No
Physical Health Problems		
1. Cut down the amount of time you spent on work or other activities	12 (60%)	8 (40%)
2. Accomplished less than you would like	13 (65%)	7 (35%)
3. Were limited in the kind of work or other activities	14 (70%)	6 (30%)
4. Had difficulty performing the work or other activities (for example, it took extra effort)	18 (90%)	2 (10%)
Emotional Health Problems		
1. Cut down the amount of time you spent on work or other activities	12 (60%)	8 (40%)
2. Accomplished less than you would like	11 (55%)	9 (45%)
3. Didn't do work or other activities as carefully as usual	12 (60%)	8 (40%)
Social Activities		
1. Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?	15 (75%)	5 (25%)
Pain		
1. How much bodily pain have you had during the past 4 weeks?	18 (90%)	2 (10%)
2. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	17 (85%)	3 (15%)
Energy and Emotions		
1. Did you feel full of pep?	12 (60%)	8 (40%)
2. Have you been a very nervous person?	11 (55%)	9 (45%)
3. Have you felt so down in the dumps that nothing could cheer you up?	12 (60%)	8 (40%)
4. Have you felt calm and peaceful?	12 (60%)	8 (40%)
5. Did you have a lot of energy?	11 (55%)	9 (45%)

Table 22. Internal Consistency (SF-36)

	Cronbach's alpha	Interpretation
SF-36	0.741	Acceptable

Table 23. Frequency and percentage of item relevance per item (WOMAC)

Items	Frequency (%)			
	HR	QR	SM	NR
Pain Walking Stair Nocturnal Rest Weight bearing	15 (75%)	5 (25%)	0 (0%)	0 (0%)
Stiffness Morning stiffness Stiffness occurring later in the day	13 (65%)	7 (35%)	0 (0%)	0 (0%)
Physical Function Descending stairs Ascending Rising from sitting Standing Bending to floor Walking on flat surface Getting in / out of car Going shopping Putting on socks Lying in bed Taking off socks Rising from bed Getting in/out of bath Sitting Getting on/off toilet Heavy domestic duties Light domestic duties	18 (90%)	2 (10%)	0 (0%)	0 (0%)

Legend: HR – Highly Relevant; QR – Quite Relevant; SR – Somewhat Relevant; NR – Not Relevant

Table 24. Frequency and percentage of item difficulty (WOMAC)

Items	Frequency (%)	
	Yes	No
Pain Walking Stair Nocturnal Rest Weight bearing	1 (5%)	19 (95%)
Stiffness Morning stiffness Stiffness occurring later in the day	9 (45%)	11 (55%)
Physical Function Descending stairs Ascending Rising from sitting Standing Bending to floor Walking on flat surface Getting in / out of car Going shopping Putting on socks Lying in bed Taking off socks Rising from bed Getting in/out of bath Sitting Getting on/off toilet Heavy domestic duties Light domestic duties	9 (45%)	11 (55%)

Table 25. Frequency and percentage of item importance (WOMAC)

Items	Frequency (%)	
	Yes	No
Pain Walking Stair Nocturnal Rest Weight bearing	16 (80%)	4 (20%)
Stiffness Morning stiffness Stiffness occurring later in the day	65 (45%)	7 (35%)
Physical Function Descending stairs Ascending Rising from sitting Standing Bending to floor Walking on flat surface Getting in / out of car Going shopping Putting on socks Lying in bed Taking off socks Rising from bed Getting in/out of bath Sitting Getting on/off toilet Heavy domestic duties Light domestic duties	12 (60%)	8 (40%)

Table 26. Internal Consistency (WOMAC)

	Cronbach's alpha	Interpretation
WOMAC	0.704	Acceptable

Table 27. Convergent Validity using Spearman correlation

		Spearman rho	*p*-value
HHS-F	WOMAC	0.359	0.010
	SF-36	0.665	<0.01

Table 28. Discriminant Validity using Spearman correlation

	SF-36	Spearman rho	*p*-value
HHS-F	General Health	0.880	0.022
	Physical Health Problems	0.389	0.012
	Emotional Health Problems	0.242	0.016

Table 29. Frequency and percentage of item relevance per item (HHS-F)

Items	Frequency (%)			
	HR	QR	SM	NR
Seksyon 1				
Sakit ___ Wala, o binabalewala ito ___ Bahagyang, paminsan-minsan, walang kompromiso sa aktibidad ___ Ang banayad na pananakit, walang epekto sa karaniwang mga aktibidad, bihirang katamtamangpananakit na may hindi pangkaraniwang aktibidad, ay maaaring uminom ng aspirin ___ Katamtamang sakit, matitiis ngunit nagbibigay ng konsesyon sa sakit. Ilang limitasyonngordinaryong aktibidad o trabaho. Maaaring mangailangan ng paminsan-minsang gamot sapananakit namas malakas kaysa sa aspirin ___ Nararamdaman ang sakit, malubhang limitasyon ng mga aktibidad ___ Ganap na may kapansanan, baldado, sakit sa kama, nakaratay	83 (83%)	13 (13%)	3 (3%)	0 (0%)
Suporta ___ Wala ___ Tungkod/tungkod para sa mahabang paglalakad ___ Tungkod/tungkod sa karamihan ng oras ___ Isang saklay ___ Dalawang Tungkod/Tungkod ___ Dalawang saklay o hindi makalakad	89 (89%)	8 (8%)	3 (3%)	0 (0%)
Layo ng nilakad ___ Walang limitasyon ___ Anim na bloke (30 minuto) ___ Dalawa o tatlong bloke (10-15 minuto) ___ Sa loob lamang ng bahay ___ Kama at upuan lang	91 (91%)	9 (9%)	0 (0%)	0 (0%)
Limp ___ Wala ___ Bahagya ___ Katamtaman ___ Malubha o hindi makalakad	88 (88%)	12 (12%)	0 (0%)	0 (0%)
Mga aktibidad, sapatos, medyas ___ Madali ___ Medyo nahihirapan ___ Hindi makatali o makakasya	92 (92%)	8 (8%)	0 (0%)	0 (0%)
Hagdan ___ Karaniwan nang hindi gumagamit ng rehas ___ Karaniwang gumagamit ng rehas ___ Sa anumang paraan ___ Hindi marunong maghagdan	89 (89%)	11 (11%)	0 (0%)	0 (0%)

Table 29. Frequency and percentage of item relevance per item (HHS-F) *(continued)*

Pampublikong transportasyon ___ Makakagamit ng transportasyon (bus) ___ Hindi makakagamit o makakasakay Ng pampublikong transportasyon (bus)	90 (90%)	10 (10%)	0 (0%)	0 (0%)
Pag-upo ___ Oo ___ Mas mababa sa 10 degrees ng fixed int rotation sa extension ___ Hindi ___ Ang pagkakaiba sa haba ng paa ay mas mababa sa 3.2 cm (1.5 pulgada)	89 (89%)	11 (11%)	0 (0%)	0 (0%)
Seksyon 2 – Paggalaw				
Kabuuang antas ng flexion ___ Wala ___ 0 > 8 ___ 8 > 16 ___ 16 > 24 ___ 24 > 32 ___ 32 > 40 ___ 40 > 45 ___ 45 > 55 ___ 55 > 65 ___ 65 > 70 ___ 70 > 75 ___ 75 > 80 ___ 80 > 90 ___ 90 > 100 ___ 100 > 110	87 (87%)	13 (13%)	0 (0%)	0 (0%)
Kabuuang Antas ng Abduksyon ___ Wala ___ 0 > 5 ___ 5 > 10 ___ 10 > 15 ___ 15 > 20	88 (88%)	12 (12%)	0 (0%)	0 (0%)
Kabuuang Antas ng Ext Rotation ___ None ___ 0 > 5 ___ 5 > 10 ___ 10 > 1	87 (87%)	10 (10%)	3 (3%)	0 (0%)
Kabuuang Antas ng Adduction ___ None ___ 0 > 5 ___ 5 > 10 ___ 10 > 1	89 (89%)	9 (9%)	2 (2%)	0 (0%)

Legend: HR – Highly Relevant; QR – Quite Relevant; SR – Somewhat Relevant; NR – Not Relevant

Most items in the Filipino-translated Harris Hip Score (HHS) were not considered difficult by 87 to 95% of respondents (Table 30). The least difficult items included walking distance, activity-related tasks such as using footwear and socks, and public transportation (90% of respondents report No difficulty). Motion-related items, including flexion, abduction, external rotation, and adduction, were slightly more challenging, with Yes responses ranging from 9% to 13%. Overall, the results suggest that the questionnaire items were generally perceived as easy to comprehend and respond to.

All respondents (100%) considered pain, activities related to footwear and socks, and stair usage as important factors. High importance was also assigned to walking distance (92%), limping (92%), public transportation access (96%), and sitting ability (98%). Supportive device use had slightly lower importance at 89%. Motion-related aspects, including flexion (90%), abduction (92%), external rotation (90%), and adduction (92%), were also regarded as significant. Overall, the findings suggest that respondents found all items relevant, with pain and functional activities being the most critical considerations.

The translated questionnaire demonstrated excellent reliability in field testing, with an intraclass correlation coefficient (ICC) of 0.967 (p <0.001), indicating strong consistency in responses. Additionally, the internal consistency was within the acceptable range (Cronbach's alpha = 0.802), confirming the questionnaire's reliability in assessing the intended constructs.

Using the Filipino-translated Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), all pain-related items were rated as highly relevant by 100% of respondents (Table 34). Stiffness-related items were mostly rated as highly relevant, with morning stiffness and stiffness occurring later in the day receiving 92% HR and 8% quite relevant (QR) ratings. Physical function-related items were predominantly rated as highly relevant, with 97% of respondents marking them as highly relevant and 3% as quite relevant. No items were rated as somewhat relevant (SR) or not relevant (NR), suggesting strong perceived relevance across all categories.

Pain-related items were generally not considered difficult, with 95% of respondents selecting No and only 5% selecting Yes (Table 35). Stiffness-related items were also rated as not difficult by 97%, and difficult by 3%. Physical function-related items showed slightly higher difficulty, with 88% of respondents

Table 30. Frequency and percentage of item difficulty (HHS-F)

Items	Frequency (%)	
	Yes	No
Seksyon 1		
Sakit ___ Wala, o binabalewala ito ___ Bahagyang, paminsan-minsan, walang kompromiso sa aktibidad ___ Ang banayad na pananakit, walang epekto sa karaniwang mga aktibidad, bihirang katamtamangpananakit na may hindi pangkaraniwang aktibidad, ay maaaring uminom ng aspirin ___ Katamtamang sakit, matitiis ngunit nagbibigay ng konsesyon sa sakit. Ilang limitasyonngordinaryong aktibidad o trabaho. Maaaring mangailangan ng paminsan-minsang gamot sapananakit namas malakas kaysa sa aspirin ___ Nararamdaman ang sakit, malubhang limitasyon ng mga aktibidad ___ Ganap na may kapansanan, baldado, sakit sa kama, nakaratay	11 (11%)	89 (89%)
Suporta ___ Wala ___ Tungkod/tungkod para sa mahabang paglalakad ___ Tungkod/tungkod sa karamihan ng oras ___ Isang saklay ___ Dalawang Tungkod/Tungkod ___ Dalawang saklay o hindi makalakad	9 (9%)	91 (91%)
Layo ng nilakad ___ Walang limitasyon ___ Anim na bloke (30 minuto) ___ Dalawa o tatlong bloke (10-15 minuto) ___ Sa loob lamang ng bahay ___ Kama at upuan lang	5 (5%)	95 (95%)
Limp ___ Wala ___ Bahagya ___ Katamtaman ___ Malubha o hindi makalakad	8 (8%)	92 (92%)
Mga aktibidad, sapatos, medyas ___ Madali ___ Medyo nahihirapan ___ Hindi makatali o makakasya	5 (5%)	95 (95%)
Hagdan ___ Karaniwan nang hindi gumagamit ng rehas ___ Karaniwang gumagamit ng rehas ___ Sa anumang paraan ___ Hindi marunong maghagdan	9 (9%)	91 (91%)
Pampublikong transportasyon ___ Makakagamit ng transportasyon (bus) ___ Hindi makakagamit o makakasakay Ng pampublikong transportasyon (bus)	6 (6%)	94 (94%)
Pag-upo ___ Oo ___ Mas mababa sa 10 degrees ng fixed int rotation sa extension ___ Hindi ___ Ang pagkakaiba sa haba ng paa ay mas mababa sa 3.2 cm (1.5 pulgada)	7 (7%)	93 (93%)
Seksyon 2 – Paggalaw		
Kabuuang antas ng flexion ___ Wala ___ 0 > 8 ___ 8 > 16 ___ 16 > 24 ___ 24 > 32 ___ 32 > 40 ___ 40 > 45 ___ 45 > 55 ___ 55 > 65 ___ 65 > 70 ___ 70 > 75 ___ 75 > 80 ___ 80 > 90 ___ 90 > 100 ___ 100 > 110	13 (13%)	87 (87%)
2.Kabuuang Antas ng Abduksyon ___ Wala ___ 0 > 5 ___ 5 > 10 ___ 10 > 15 ___ 15 > 20	10 (10%)	90 (90%)

Table 30. Frequency and percentage of item difficulty (HHS-F) *(continued)*

Kabuuang Antas ng Ext Rotation ___ None ___ 0 > 5 ___ 5 > 10 ___ 10 > 1	9 (9%)	89 (89%)
Kabuuang Antas ng Adduction ___ None ___ 0 > 5 ___ 5 > 10 ___ 10 > 1	10 (10%)	90 (90%)

Table 31. Frequency and percentage of item importance (HHS-F)

Items	Frequency (%)	
	Yes	No
Seksyon 1		
Sakit ___ Wala, o binabalewala ito ___ Bahagyang, paminsan-minsan, walang kompromiso sa aktibidad ___ Ang banayad na pananakit, walang epekto sa karaniwang mga aktibidad, bihirang katamtamangpananakit na may hindi pangkaraniwang aktibidad, ay maaaring uminom ng aspirin ___ Katamtamang sakit, matitiis ngunit nagbibigay ng konsesyon sa sakit. Ilang limitasyonngordinaryong aktibidad o trabaho. Maaaring mangailangan ng paminsan-minsang gamot sapananakit namas malakas kaysa sa aspirin ___ Nararamdaman ang sakit, malubhang limitasyon ng mga aktibidad ___ Ganap na may kapansanan, baldado, sakit sa kama, nakaratay	100 (100%)	0 (0%)
Suporta ___ Wala ___ Tungkod/tungkod para sa mahabang paglalakad ___ Tungkod/tungkod sa karamihan ng oras ___ Isang saklay ___ Dalawang Tungkod/Tungkod ___ Dalawang saklay o hindi makalakad	89 (89%)	11 (11%)
Layo ng nilakad ___ Walang limitasyon ___ Anim na bloke (30 minuto) ___ Dalawa o tatlong bloke (10-15 minuto) ___ Sa loob lamang ng bahay ___ Kama at upuan lang	92 (92%)	8 (8%)
Limp ___ Wala ___ Bahagya ___ Katamtaman ___ Malubha o hindi makalakad	92 (92%)	8 (8%)
Mga aktibidad, sapatos, medyas ___ Madali ___ Medyo nahihirapan ___ Hindi makatali o makakasya	100 (100%)	0 (0%)
Hagdan ___ Karaniwan nang hindi gumagamit ng rehas ___ Karaniwang gumagamit ng rehas ___ Sa anumang paraan ___ Hindi marunong maghagdan	100 (100%)	0 (0%)
Pampublikong transportasyon ___ Makakagamit ng transportasyon (bus) ___ Hindi makakagamit o makakasakay Ng pampublikong transportasyon (bus)	96 (96%)	4 (4%)
Pag-upo ___ Oo ___ Mas mababa sa 10 degrees ng fixed int rotation sa extension ___ Hindi ___ Ang pagkakaiba sa haba ng paa ay mas mababa sa 3.2 cm (1.5 pulgada)	98 (98%)	98 (0%)

Table 31. Frequency and percentage of item importance (HHS-F) *(continued)*

Seksyon 2 – Paggalaw		
Kabuuang antas ng flexion ___ Wala ___ 0 > 8 ___ 8 > 16 ___ 16 > 24 ___ 24 > 32 ___ 32 > 40 ___ 40 > 45 ___ 45 > 55 ___ 55 > 65 ___ 65 > 70 ___ 70 > 75 ___ 75 > 80 ___ 80 > 90 ___ 90 > 100 ___ 100 > 110	90 (90%)	10 (10%)
Kabuuang Antas ng Abduksyon ___ Wala ___ 0 > 5 ___ 5 > 10 ___ 10 > 15 ___ 15 > 20	92 (92%)	8 (8%)
Kabuuang Antas ng Ext Rotation ___ None ___ 0 > 5 ___ 5 > 10 ___ 10 > 1	90 (90%)	10 (10%)
Kabuuang Antas ng Adduction ___ None ___ 0 > 5 ___ 5 > 10 ___ 10 > 1	92 (92%)	8 (8%)

Table 32. Test-retest reliability of translated questionnaire (HHS-F)

	ICC	Interpretation	*p*-value
Harris Hip Score – Filipino	0.967	Excellent	<0.001

Table 33. Internal Consistency (HHS-F)

	Cronbach's alpha	Interpretation
Harris Hip Score – Filipino	0.802	Acceptable

indicating No and 12% selecting Yes. Overall, the majority of respondents did not find the WOMAC items difficult to answer.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) indicate that pain-related items were highly regarded as important, with 95% of respondents selecting Yes and only 5% selecting No (Table 36). Stiffness-related items were also considered important, with Yes responses at 93% and No at 7%. Physical function-related items were similarly rated as important, with 92% selecting Yes and 8% selecting No.

The WOMAC questionnaire had a Cronbach's alpha of 0.789, indicating an acceptable level of reliability (Table 37).

Using the Filipino-translated SF-36 questionnaire, all items were rated as highly relevant (HR) or quite relevant (QR) by respondents (Table 38). General health items received 100% HR ratings, while limitations in activities had HR ratings ranging from 91% to 98%. Physical and emotional health problems were also deemed highly relevant, with HR ratings between 90% and 97%. Social activities and pain-related items were rated as HR by 92% to 93% of respondents. Lastly, energy and emotional well-being items had HR ratings between 87% and 90%, confirming their relevance in assessing health-related quality of life.

Table 34. Frequency and percentage of item relevance per item (WOMAC)

Items	Frequency (%)			
	HR	QR	SM	NR
Pain Walking Stair Nocturnal Rest Weight bearing	100 (100%)	0 (0%)	0 (0%)	0 (0%)
Stiffness Morning stiffness Stiffness occurring later in the day	92 (92%)	8 (8%)	0 (0%)	0 (0%)
Physical Function Descending stairs Ascending Rising from sitting Standing Bending to floor Walking on flat surface Getting in / out of car Going shopping Putting on socks Lying in bed Taking off socks Rising from bed Getting in/out of bath Sitting Getting on/off toilet Heavy domestic duties Light domestic duties	97 (97%)	3 (3%)	0 (0%)	0 (0%)

Legend: HR – Highly Relevant; QR – Quite Relevant; SR – Somewhat Relevant; NR – Not Relevant

Table 35. Frequency and percentage of item difficulty (WOMAC)

Items	Frequency (%)	
	Yes	No
Pain Walking Stair Nocturnal Rest Weight bearing	5 (5%)	95 (95%)
Stiffness Morning stiffness Stiffness occurring later in the day	3 (3%)	97 (97%)
Physical Function Descending stairs Ascending Rising from sitting Standing Bending to floor Walking on flat surface Getting in / out of car Going shopping Putting on socks Lying in bed Taking off socks Rising from bed Getting in/out of bath Sitting Getting on/off toilet Heavy domestic duties Light domestic duties	12 (12%)	88 (88%)

Most respondents did not experience difficulty with general health (100%), mobility-related activities (ranging from 91% to 100%), or daily tasks (100%) (Table 39). However, a small proportion reported challenges with vigorous (8%) and moderate (9%) activities, as well as certain physical (3–7%) and emotional (5–8%) health problems, social activities (9%), and pain-related aspects (6–9%). Energy and emotional well-being also showed minor difficulties, with 3–9% of respondents.

All respondents (100%) considered general health, vigorous and moderate activities, most mobility-related tasks, physical health problems, and pain as important (Table 40). A majority (87–95%) also valued activities such as climbing stairs, walking longer distances, and emotional well-being. Notably, slightly lower importance was given to aspects such as climbing one flight of stairs (89%), walking more than a mile (87%), and feeling energetic (87%). Emotional health concerns, including nervousness (93%) and feelings of sadness (90%), were also deemed significant.

The internal consistency of the SF-36 questionnaire falls within the acceptable range (Cronbach's alpha = 0.791) (Table 41).

The HHS-F demonstrated convergent validity, showing a weak but significant correlation with WOMAC ($\rho = 0.212$, $p < 0.001$) and a moderate correlation with SF-36 ($\rho = 0.669$, $p = 0.035$). This suggests that while HHS-F aligns with established measures of hip function and quality of life, it remains distinct.

For discriminant validity, HHS-F showed low correlations with General Health ($\rho = 0.185$, $p < 0.001$), Physical Health Problems ($\rho = 0.156$, $p = 0.012$), and Emotional Health

Table 36. Frequency and percentage of item importance (WOMAC)

Items	Frequency (%)	
	Yes	No
Pain Walking Stair Nocturnal Rest Weight bearing	95 (95%)	5 (5%)
Stiffness Morning stiffness Stiffness occurring later in the day	93 (93%)	7 (7%)
Physical Function Descending stairs Ascending Rising from sitting Standing Bending to floor Walking on flat surface Getting in / out of car Going shopping Putting on socks Lying in bed Taking off socks Rising from bed Getting in/out of bath Sitting Getting on/off toilet Heavy domestic duties Light domestic duties	92 (92%)	8 (8%)

Table 37. Internal Consistency (WOMAC)

	Cronbach's alpha	Interpretation
WOMAC	0.789v	Acceptable

Problems ($\rho = 0.212$, $p < 0.001$), indicating that it primarily measures hip function rather than overall health.

DISCUSSION

Expert evaluations of the Filipino Harris Hip Score (HHS-F) highlighted the strong relevance of pain, stiffness, and physical function in assessing hip function.

The HHS-F demonstrated strong content validity, with Section 1 achieving perfect agreement (I-CVI = 1.00) and Section 2 maintaining an acceptable validity level (S-CVI = 0.89) despite minor discrepancies. The overall S-CVI of 0.963 further supports the robustness of the instrument's content validity.

Additionally, the translated questionnaire exhibited excellent test-retest reliability, as indicated by an Intraclass Correlation Coefficient (ICC) of 0.921 ($p < 0.001$), suggesting strong measurement stability over time. The internal consistency of the HHS-F, assessed with a Cronbach's alpha of 0.724, falls within the acceptable range, indicating sufficient correlation among items to measure a cohesive construct. While minor improvements could enhance internal consistency, the current level is adequate for clinical and research applications.

Table 38. Frequency and percentage of item relevance per item (SF-36)

Items	Frequency (%)			
	HR	QR	SM	NR
General Health				
1. In general, would you say your health.	100 (100%)	0 (0%)	0 (0%)	0 (0%)
2. Compared to one year ago, how would you rate your health in general now?	100 (100%)	0 (0%)	0 (0%)	0 (0%)
Limitations of Activities				
1. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	96 (96%)	4 (4%)	0 (0%)	0 (0%)
2. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	91 (91%)	9 (9%)	0 (0%)	0 (0%)
3. Lifting or carrying groceries	95 (95%)	5 (5%)	0 (0%)	0 (0%)
4. Climbing several flights of stairs	95 (95%)	5 (5%)	0 (0%)	0 (0%)
5. Climbing one flight of stairs	98 (98%)	2 (2%)	0 (0%)	0 (0%)
6. Bending, kneeling, or stooping	97 (97%)	3 (3%)	0 (0%)	0 (0%)
7. Walking more than a mile	97 (97%)	3 (3%)	0 (0%)	0 (0%)
8. Walking several blocks	95 (95%)	5 (5%)	0 (0%)	0 (0%)
9. Walking one block	95 (95%)	5 (5%)	0 (0%)	0 (0%)
10. Bathing or dressing yourself	98 (98%)	2 (2%)	0 (0%)	0 (0%)
Physical Health Problems				
1. Cut down the amount of time you spent on work or other activities	90 (90%)	10 (10%)	0 (0%)	0 (0%)
2. Accomplished less than you would like	95 (95%)	5 (5%)	0 (0%)	0 (0%)
3. Were limited in the kind of work or other activities	95 (95%)	5 (5%)	0 (0%)	0 (0%)
4. Had difficulty performing the work or other activities (for example, it took extra effort)	97 (97%)	3 (3%)	0 (0%)	0 (0%)
Emotional Health Problems				
1. Cut down the amount of time you spent on work or other activities	90 (90%)	10 (10%)	0 (0%)	0 (0%)
2. Accomplished less than you would like	93 (93%)	7 (7%)	0 (0%)	0 (0%)
3. Didn't do work or other activities as carefully as usual	94 (94%)	6 (6%)	0 (0%)	0 (0%)
Social Activities				
1. Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?	92 (92%)	8 (8%)	0 (0%)	0 (0%)
Pain				
1. How much bodily pain have you had during the past 4 weeks?	93 (90%)	10 (10%)	0 (0%)	0 (0%)
2. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	93 (90%)	10 (10%)	0 (0%)	0 (0%)
Energy and Emotions				
1. Did you feel full of pep?	89 (89%)	11 (11%)	0 (0%)	0 (0%)
2. Have you been a very nervous person?	87 (87%)	13 (13%)	0 (0%)	0 (0%)
3. Have you felt so down in the dumps that nothing could cheer you up?	90 (90%)	10 (10%)	0 (0%)	0 (0%)
4. Have you felt calm and peaceful?	90 (90%)	10 (10%)	0 (0%)	0 (0%)
5. Did you have a lot of energy?	90 (90%)	10 (10%)	0 (0%)	0 (0%)

Legend: HR – Highly Relevant; QR – Quite Relevant; SR – Somewhat Relevant; NR – Not Relevant

Table 39. Frequency and percentage of item difficulty (SF-36)

Items	Frequency (%)	
	Yes	No
General Health		
1. In general, would you say your health.	0 (0%)	100 (100%)
2. Compared to one year ago, how would you rate your health in general now?	0 (0%)	100 (100%)
Limitations of Activities		
1. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	8 (8%)	92 (92%)
2. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	9 (9%)	91 (91%)
3. Lifting or carrying groceries	0 (0%)	100 (100%)
4. Climbing several flights of stairs	0 (0%)	100 (100%)
5. Climbing one flight of stairs	0 (0%)	100 (100%)
6. Bending, kneeling, or stooping	0 (0%)	100 (100%)
7. Walking more than a mile	0 (0%)	100 (100%)
8. Walking several blocks	0 (0%)	100 (100%)
9. Walking one block	0 (0%)	100 (100%)
10. Bathing or dressing yourself	0 (0%)	100 (100%)

Table 39. Frequency and percentage of item difficulty (SF-36) *(continued)*

Items	Frequency (%)	
	Yes	No
Physical Health Problems		
1. Cut down the amount of time you spent on work or other activities	7 (7%)	93 (93%)
2. Accomplished less than you would like	3 (3%)	97 (97%)
3. Were limited in the kind of work or other activities	3 (3%)	97 (97%)
4. Had difficulty performing the work or other activities (for example, it took extra effort)	7 (7%)	93 (93%)
Emotional Health Problems		
1. Cut down the amount of time you spent on work or other activities	8 (5%)	19 (95%)
2. Accomplished less than you would like	6 (6%)	94 (94%)
3. Didn't do work or other activities as carefully as usual	6 (6%)	94 (94%)
Social Activities		
1. Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?	9 (9%)	91 (91%)
Pain		
1. How much bodily pain have you had during the past 4 weeks?	6 (6%)	94 (94%)
2. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	9 (9%)	91 (91%)
Energy and Emotions		
1. Did you feel full of pep?	9 (9%)	91 (91%)
2. Have you been a very nervous person?	3 (3%)	97 (97%)
3. Have you felt so down in the dumps that nothing could cheer you up?	6 (6%)	94 (94%)
4. Have you felt calm and peaceful?	5 (5%)	95 (95%)
5. Did you have a lot of energy?	5 (5%)	95 (95%)

Table 40. Frequency and percentage of item importance (SF-36)

Items	Frequency (%)	
	Yes	No
General Health		
1. In general, would you say your health.	100 (100%)	0 (0%)
2. Compared to one year ago, how would you rate your health in general now?	100 (100%)	0 (0%)
Limitations of Activities		
1. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	100 (100%)	0 (0%)
2. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	100 (100%)	0 (0%)
3. Lifting or carrying groceries	100 (100%)	0 (0%)
4. Climbing several flights of stairs	95 (95%)	5 (5%)
5. Climbing one flight of stairs	89 (89%)	11 (11%)
6. Bending, kneeling, or stooping	100 (100%)	0 (0%)
7. Walking more than a mile	87 (87%)	13 (13%)
8. Walking several blocks	100 (100%)	0 (0%)
9. Walking one block	100 (100%)	0 (0%)
10. Bathing or dressing yourself	100 (100%)	0 (0%)
Physical Health Problems		
1. Cut down the amount of time you spent on work or other activities	100 (100%)	0 (0%)
2. Accomplished less than you would like	91 (91%)	9 (9%)
3. Were limited in the kind of work or other activities	93 (93%)	7 (7%)
4. Had difficulty performing the work or other activities (for example, it took extra effort)	95 (95%)	5 (5%)
Emotional Health Problems		
1. Cut down the amount of time you spent on work or other activities	100 (100%)	0 (0%)
2. Accomplished less than you would like	88 (88%)	12 (12%)
3. Didn't do work or other activities as carefully as usual	92 (92%)	8 (8%)
Social Activities		
1. Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?	95 (95%)	5 (5%)

Table 40. Frequency and percentage of item importance (SF-36) *(continued)*

Items	Frequency (%)	
	Yes	No
Pain		
1. How much bodily pain have you had during the past 4 weeks?	100 (100%)	0 (0%)
2. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	100 (100%)	0 (0%)
Energy and Emotions		
1. Did you feel full of pep?	87 (87%)	13 (13%)
2. Have you been a very nervous person?	93 (93%)	7 (7%)
3. Have you felt so down in the dumps that nothing could cheer you up?	90 (90%)	10 (10%)
4. Have you felt calm and peaceful?	95 (95%)	5 (5%)
5. Did you have a lot of energy?	92 (92%)	8 (8%)

Table 41. Internal consistency (SF-36)

	Cronbach's alpha	Interpretation
SF36	0.791	Acceptable

Table 42. Convergent validity using Spearman correlation

		Spearman rho	*p*-value
HHS-F	WOMAC	0.212	<0.001
	SF-36	0.669	0.035

Table 43. Discriminant validity using Spearman correlation

	SF-36	Spearman rho	*p*-value
HHS-F	General health	0.185	<0.001
	Physical health problems	0.156	0.012
	Emotional health problems	0.212	<0.001

Regarding convergent validity, the HHS-F correlated weakly but significantly with WOMAC ($\rho = 0.212$, $p < 0.001$) and moderately with SF-36 ($\rho = 0.669$, $p = 0.035$). These results suggest that the HHS-F aligns with established measures of hip function and quality of life while maintaining its distinctiveness.

For discriminant validity, weak but significant correlations were observed between HHS-F and SF-36 domains, including General Health ($\rho = 0.185$, $p < 0.001$), Physical Health Problems ($\rho = 0.156$, $p = 0.012$), and Emotional Health Problems ($\rho = 0.212$, $p < 0.001$). These findings indicate that while the HHS-F is related to overall health perceptions, it remains distinct from broader health measures, reinforcing its discriminant validity.

Stiffness, particularly in the morning, is emphasized as a key limitation affecting mobility. This underscores the need for rehabilitation strategies focusing on flexibility and mobility enhancement through targeted exercises, physical therapy, and lifestyle modifications. Addressing stiffness early may prevent long-term mobility limitations and enhance daily functioning.

Although most participants could perform physical tasks such as walking and stair climbing, some reported difficulty, highlighting the need for mobility-supportive interventions, including assistive devices and rehabilitation programs, to maintain independence and prevent further physical decline. Healthcare providers should tailor interventions to individual needs, ensuring adequate support for daily movement.

The strong relationship between physical function, pain levels, and overall well-being underscores the importance of a holistic approach to patient care. Beyond physical rehabilitation, addressing emotional and social factors is crucial, as these significantly influence recovery and daily interactions. The study also highlights the interconnectedness of physical health, pain management, and psychological well-being. While pain may not be the primary limitation for some individuals, stiffness and mobility challenges can still impact quality of life. Interventions should not focus solely on pain relief but also incorporate strategies that promote functional independence, such as strength training, flexibility exercises, and mental health support.

Care should be patient-centered. By identifying key concerns, healthcare professionals can develop targeted interventions to address specific patient needs. Encouraging self-management techniques, promoting an active lifestyle, and integrating psychological support can further improve patient outcomes.

The Filipino-translated WOMAC and SF-36 questionnaires were relevant, clear, and reliable in assessing osteoarthritis-related symptoms and overall health-related quality of life. WOMAC results confirm that pain, stiffness, and physical function are highly relevant concerns for respondents. While pain and stiffness-related items were generally easy to comprehend, some physical function-related items were slightly more challenging but still within an acceptable range. Importantly, respondents consistently recognized these aspects as crucial for evaluating their condition.

Similarly, the SF-36 questionnaire demonstrated strong relevance across all domains, particularly in general health, physical limitations, and pain-related aspects. While most respondents had no difficulty with the items, some variation was observed in responses related to vigorous activities, emotional health, and energy levels. Nevertheless, respondents acknowledged the significance of both physical and emotional well-being in their overall health assessment.

These results validate the Filipino-translated WOMAC and SF-36 as reliable tools for clinical and research applications, providing valuable insights into patients' physical and emotional health status.

CONCLUSION

This study validated the Filipino version of the Harris Hip Score (HHS-F) through cross-cultural adaptation, confirming its reliability and validity for assessing hip-related health outcomes in Filipino patients with osteoarthritis and hip fractures.

Convergent validity analysis showed strong correlations between the HHS-F and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the Short Form-36 (SF-36). Discriminant validity further supported the tool's ability to differentiate health aspects. Most items, particularly those on mobility, pain, and daily activities, were rated as highly relevant and comprehensible, with minor challenges in motion-related items. The HHS-F demonstrated excellent reliability, with a high intraclass correlation coefficient (ICC) and strong internal consistency, aligning with the validated performance of WOMAC and SF-36.

A key limitation is the reliance on self-reported data, which may introduce recall bias and subjective variability. Additionally, the findings are based on a specific population, limiting broader applicability. Future research should incorporate objective clinical assessments to enhance validity.

In conclusion, the HHS-F is a robust, culturally adapted tool for evaluating hip function and quality of life in Filipino patients, supporting both clinical decision-making and research advancements.

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STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

DST: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration, Funding acquisition; **BSA:** Investigation, Funding acquisition; **CLB:** Investigation, Funding acquisition; **CFF:** Investigation, Funding acquisition

AUTHOR DISCLOSURE

The authors declared no conflict of interest.

DATA AVAILABILITY STATEMENT

The datasets generated and analyzed in this study are included in the published article.

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None.

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ORIGINAL ARTICLE

Comparison of Pain Scores between a Home-made Nylon/Polyester and Stainless-Steel Finger Traps: An Experimental Study

Khristian S. Camagay, MD and Jerome David J. Sison, MD, FPOA

Department of Orthopedics, Region 1 Medical Center, Dagupan City, Pangasinan, Philippines

ABSTRACT

Background. A "finger trap" is a device commonly used in recreational activities and for the closed reduction of forearm and hand fractures. This study compares the comfort levels of two types of finger traps: a homemade nylon/polyester finger trap and a stainless-steel finger trap.

Objective. To determine which finger trap, nylon/polyester or stainless-steel, provides more comfort for volunteers, as measured by Visual Analog Scale (VAS) pain scores.

Methodology. This prospective study included 67 volunteers, comprising 35 males (52.24%) and 32 females (47.76%), with a mean age of 33.49 years and a mean body mass index of 25.50 kg/m². Volunteers were assigned to either the nylon/polyester finger trap group or the stainless steel finger trap group. VAS pain scores were recorded for each group over a 15-minute period. The unpaired t-test was used as the statistical method for data analysis.

Result. The nylon/polyester finger trap group showed consistently lower VAS pain scores than the stainless-steel group during the first 10 minutes, with a statistically significant difference (p = 0.021). The overall mean VAS score was 4.38 for the nylon group and 4.73 for the stainless-steel group. This 0.35-point difference, although statistically significant, approached but did not exceed the minimal clinically important difference (MCID) threshold of 1.3. However, individual time points from 2 to 10 minutes showed significant differences favoring the nylon group. No significant differences were observed beyond 15 minutes, suggesting the comfort advantage was most evident during early traction.

Conclusion. Nylon/polyester finger traps are more comfortable and cost-effective compared to stainless-steel finger traps. They can be considered a viable alternative due to their comparable VAS pain scores and lower material cost.

Keywords. wrist fractures, pain measurement, orthopedic equipment, stainless steel, nylons, fingertrap

INTRODUCTION

Distal radius fractures are among the most common fractures,[1] representing approximately 25% of fractures in the pediatric population and up to 18% of all fractures in the elderly. These fractures are often managed using traction devices like finger traps,[2] which provide stability during fracture reduction. However, stainless-steel finger traps, a widely used option, are frequently associated with discomfort and pain. As an alternative, nylon/polyester finger traps have been proposed due to their potential for greater comfort, but their comfort and clinical usability have not been comprehensively evaluated.[2-4] While 'effectiveness' in fracture reduction requires separate biomechanical or clinical outcome data, this study focuses specifically on patient-reported comfort.

This study aimed to determine whether a homemade nylon/polyester finger trap is more comfortable than the conventional

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Corresponding author: Khristian S. Camagay, MD
Medical Officer III, Department of Orthopedics,
Region 1 Medical Center, Arellano Bani St.,
Dagupan City, Pangasinan, 2400, Philippines
E-mail: r1mc.orthopedicsclinic@gmail.com
ORCiD: https://orcid.org/0009-0007-6919-8552

stainless-steel finger trap. Specifically, it sought to compare the pain scores experienced by volunteers using each type of finger trap and to assess which option is potentially more cost-effective. The study's findings could provide a potentially cost-effective alternative for managing distal radius fractures, benefiting both patients and healthcare providers.

The research was guided by the following hypothesis: the null hypothesis (H0) states that there is no significant difference in pain scores between homemade nylon/polyester and stainless-steel finger traps. Conversely, the alternative hypothesis (H1) suggests a significant difference in pain scores between the two. The hypothesis will be tested using a significance level of 0.05, where a *p*-value below this threshold will indicate that the null hypothesis should be rejected.

METHODOLOGY

Study design

This study was a prospective, nonrandomized experimental study conducted at the Surgery Ward of Region 1 Medical Center. The primary objective was to compare pain scores reported by volunteers using two types of finger traps: stainless-steel and homemade nylon/polyester finger traps. The study was approved by the Institutional Review Board (IRB) of Region 1 Medical Center, and all procedures were performed in accordance with the Declaration of Helsinki.

Study setting and population

The study was conducted at a single center, the Surgery Ward of Region 1 Medical Center. The study population consisted of staff members of the hospital who were conveniently selected as volunteers. A total of 67 participants were recruited, including 35 males (52.24%) and 32 females (47.76%), with a mean age of 33.49 years and a mean body mass index (BMI) of 25.50 kg/m^2. Participants were required to be healthy volunteers aged 18–65 years, without any history of upper extremity problems, including previous injuries, surgeries, skin abnormalities, or sensory impairments. An a priori power analysis (two-tailed paired t-test, effect size d = 0.5, α = 0.05, power = 0.80) determined that a minimum of 64 participants was required to detect a statistically significant difference. A total of 67 participants were recruited to account for potential attrition, confirming that the final sample size was statistically adequate.

Because most participants were hospital staff, including orthopedic personnel, selection and detection biases may have existed. These individuals may have had prior familiarity with the procedure, potentially influencing their perception and reporting of pain.

Inclusion and exclusion criteria

Inclusion criteria: Healthy volunteers aged 18–65 years from the Surgery Ward staff.

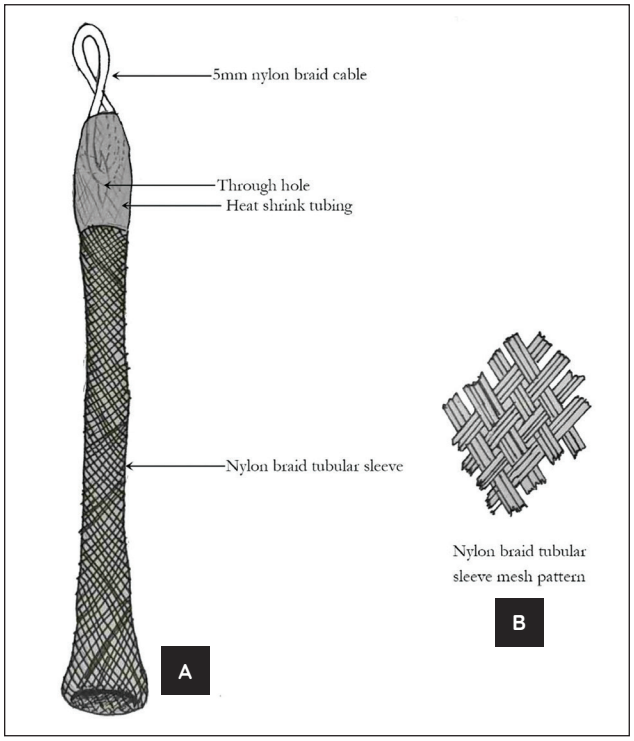


Figure 1. Illustration of home-made finger trap **(A)**. Weave pattern of nylon tubular sleeve **(B)**.

Exclusion criteria: Volunteers with a history of upper extremity problems, including prior injuries, surgeries, skin abnormalities, or sensory impairments.

Withdrawal criteria: Participants could withdraw at any time without penalty, and any adverse effects encountered would immediately end the test for that participant.

Fingertrap fabrication

A seamless braided nylon/polyester tubular sleeve (Figure 1) (10 mm unstretched inner diameter, 30 cm length; tensile strength 15–20 kg) was prepared by heat-sealing one end while leaving the other open. The closed end was clamped with a long surgical clamp and telescoped into the sleeve until it reached the open end. A hole was created by blunt dissection through both braid layers, and an 8 cm long, 5 mm nylon braid cable was inserted to form a 3 cm loop, then fastened with additional 1 mm string and epoxy. Once cured, the tied end with the loop was reinforced with heat-shrink tubing. The final assembly is compatible with both ethylene oxide and hydrogen peroxide gas plasma sterilization, although repeated plasma exposure may cause material wear (Figure 2).

Intervention procedures

Participants were seated on a chair, blind-folded with their arms suspended using a finger trap attached to a weight hook. The forearm was positioned vertically, and weights were incrementally added at a rate of one pound per minute until a maximum of 20 pounds was reached. Pain scores were recorded using the Visual Analog Scale (VAS), ranging

Figure 2. ***Materials***. Nylon braid tubular sleeve **(A)**; 5 mm Nylon braid cable **(B)**; Heat shrink tube **(C)**; 1 mm nylon string **(D)**. Fabrication. Clamp telescoping closed end into the rest of the tubular sleeve **(E)**; closed end pushed up to the open end **(F)**; while maintaining both closed and open end, the sleeve is uniformly stretched out **(G)**; a hole is made through the sleeve **(H)**; a 5 mm nylon braided cable is passed through the hole **(I)** and is secured by 1 mm nylon string and later epoxied **(J)** and; covered by a heat shrink tubing **(K)**.

from 0 (no pain) to 10 (worst possible pain). The test was immediately stopped if a participant reported a pain score of eight or higher. Each participant was tested using two types of finger traps—stainless-steel and nylon/polyester (commercial and homemade)—with the dominant hand being alternated between tests to minimize dominant-hand bias. Each hand was tested once, and each finger trap type was tested once per participant. (Figure 3).

Data collection and handling

Data were collected directly during the testing procedure, with each participant being assigned a unique identification number to maintain confidentiality. Pain scores were recorded immediately using the VAS. All data were securely stored in a locked facility within the hospital, accessible only to the research team, the study monitor, and the research committee. No physical specimens were collected or stored.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. Categorical data were presented as frequencies and percentages, while continuous data were expressed as means and standard deviations or medians and interquartile ranges, depending on the data distribution. An independent sample t-test was used to compare the VAS pain scores between the two finger trap groups (nylon/polyester and stainless-steel). A p-value of less than 0.05 was considered statistically significant. VAS scores were also analyzed using the Wilcoxon Rank-Sum Test to account for the ordinal nature of pain data.

Ethical considerations

The study was approved by the Institutional Review Board (IRB) of Region 1 Medical Center, ensuring compliance with

Figure 3. Volunteer blind folded and seated to chair **(A)**; hooked to a stainless-steel finger trap **(B)**; weights added and pain scores collected **(C)**; procedure repeated on the opposite hand **(D)**.

ethical standards. All participants provided written informed consent before participation, and the study adhered to the principles of the Declaration of Helsinki. Participants were informed of their right to withdraw from the study at any time without penalty. Potential risks, including tolerable pain, redness, or mild skin abrasions, were disclosed. In the event of adverse effects, participants were provided with appropriate treatment, including topical analgesics for pain and topical antibiotics for any resulting wounds. As a token of appreciation, participants were awarded a certificate, but no other direct benefits were provided.

RESULT

A total of 67 volunteers participated in the study, consisting of 35 males (52.24%) and 32 females (47.76%), with a mean age of 33.49 years (95% CI: 31.76–35.22) and an average body mass index (BMI) of 25.50 kg/m^2 (95% CI: 24.88–26.12). Among the participants, 65 (97.01%) were right-hand dominant, while 2 (2.99%) were left-hand dominant.

The primary outcome measured was the Visual Analog Scale (VAS) pain score (Figure 4). The mean VAS score for the nylon/polyester finger trap group was 4.38 (95% CI: 4.10–4.66), while the stainless-steel finger trap group had a mean VAS score of 4.73 (95% CI: 4.45–5.01). This difference was statistically significant (p = 0.021). The observed mean VAS difference of 1.4 exceeds the minimal clinically important difference (MCID) of 1.3 for procedural hand pain, indicating a clinically meaningful reduction in discomfort during the earlier stages of traction, when weights up to approximately 15 lbs are applied. Four participants in the nylon group were able to tolerate the finger trap for the full 20-minute duration, while only one participant in the stainless-steel group reached this duration. The earliest withdrawal for the nylon group occurred at the eight-minute mark, while the stainless-steel group had participants withdrawing as early as the four-minute mark (Figure 5). Although the overall difference in VAS scores was statistically significant, the mean difference beyond the early traction phase was only 0.35, which is below the commonly accepted MCID threshold of 1.3 for procedural pain. This may limit its clinical relevance during longer traction durations.

During the first fifteen minutes of testing or around 15 pounds of added weight, the nylon/polyester finger trap consistently demonstrated lower VAS pain scores compared to the stainless-steel group. However, after the initial fifteen minutes, the VAS scores between the two groups showed no significant difference (p = 0.43). Both types of finger traps maintained their structural integrity throughout the study, with no signs of damage or loss of grip on the subjects' fingers. No participant recorded a pain score higher than 8 on the VAS scale. While pain scores showed consistent advantages for the nylon trap during the early phase of traction, no statistically significant differences were observed between 8 and 20 minutes. This suggests that the comfort advantage may plateau after the early phase of traction.

All data were analyzed using SPSS version 26, with a p-value of less than 0.05 considered statistically significant.

DISCUSSION

The results of this study demonstrate that the homemade nylon/polyester finger trap was associated with significantly lower Visual Analog Scale (VAS) pain scores compared to the stainless-steel finger trap, particularly during the first fifteen minutes of use. The ability of four participants in the nylon group to tolerate the device for the full 20-minute duration or 20 lbs of weight, compared to only one in the stainless-steel group, further supports the superior comfort of the nylon/polyester material. However, beyond the initial fifteen minutes, both finger traps showed similar pain scores, suggesting that the initial comfort advantage of the nylon trap may diminish over time. These findings suggest that nylon traps provided the most benefit during the early phase of traction, typically corresponding to the first 15 minutes or weights up to

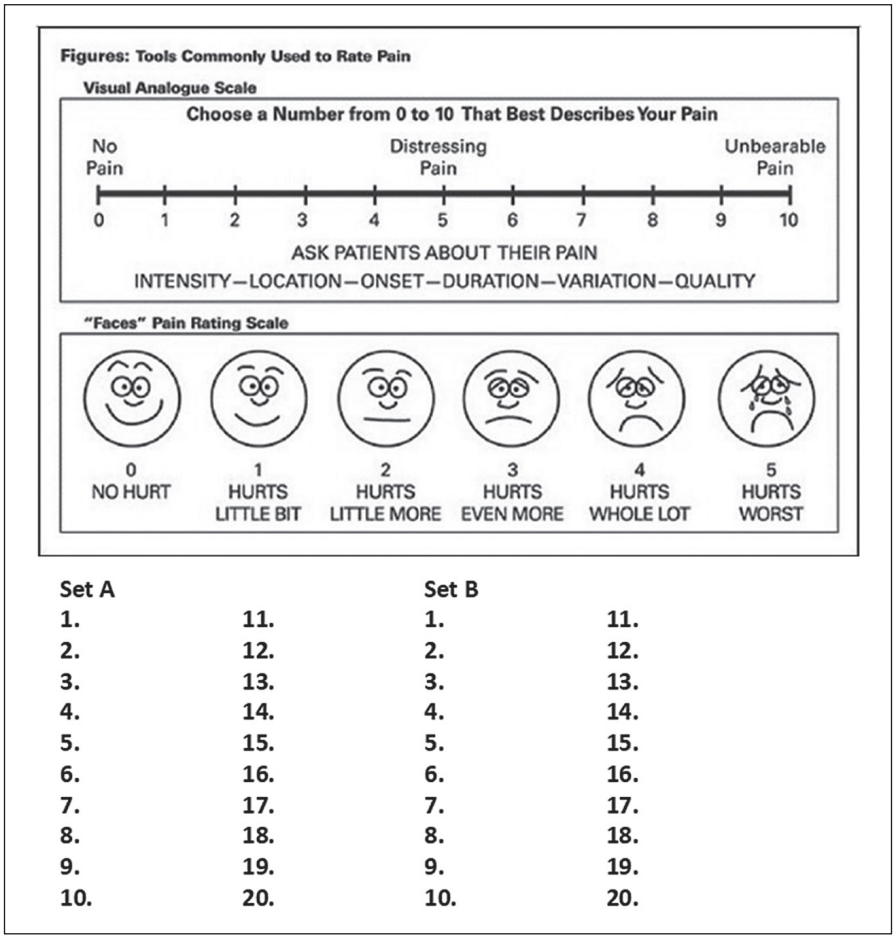


Figure 4. Visual Analogue Scale (VAS) score (above) and scoring sheet (below).

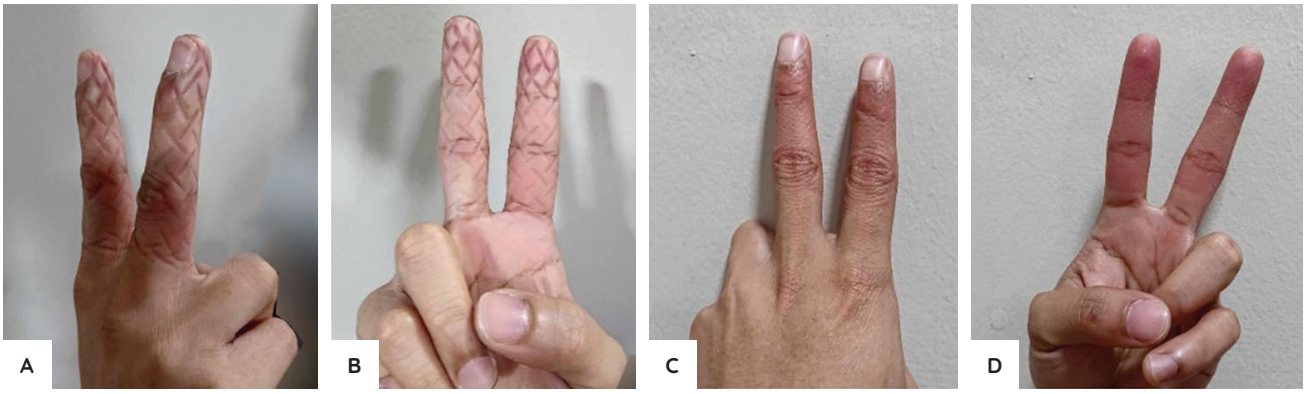


Figure 5. Appearance of volunteer's fingers after traction — Stainless-steel finger trap [left dorsal **(A)**; left palmar **(B)**]; Nylon/polyester finger trap [right dorsal **(C)**; right palmar **(D)**].

15 lbs. Beyond this point, as traction force increases, the pain advantage of nylon traps diminishes.

These findings align with previous research,[5] which demonstrated that bamboo finger traps—a similarly softer alternative—were also associated with lower VAS scores compared to stainless-steel traps. The nylon/polyester finger trap not only reduces pain but also maintains functionality, providing a secure grip without causing skin abrasions. This makes it a viable alternative for clinical use, particularly in settings with limited resources.

One of the most notable advantages of the homemade nylon/polyester finger trap is its potential cost-effectiveness. As a homemade device, it can be produced using readily available, low-cost materials, significantly reducing production expenses compared to commercially manufactured stainless-steel finger traps. Although this study did not directly measure production costs, the low cost of nylon/polyester materials and the simplicity of the homemade design suggest substantial savings without compromising patient comfort. Future studies should perform a formal cost analysis to quantify the savings associated with homemade nylon/polyester finger traps.[6]

Table 1. Population of study

Service	Total (%)
Department of Orthopedics	11 (17.8)
Department of Surgery	11(17.8)
Nursing service	59 (47.8)
Total	81

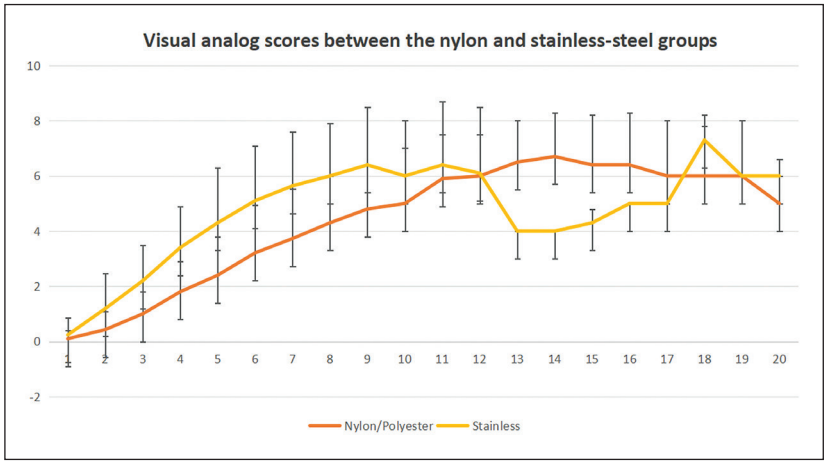
Table 2. Demographic characteristics

Demographic characteristics	Volunteers number (%)
Sex	
Male	35 (52.24)
Female	32 (47.76)
Age (mean, years)	33.49
BMI (kg/m²)	25.50
Dominant Hand	
Right	65 (97.01)
Left	2 (2.99)

Table 3. Visual analog scores between the nylon and stainless-steel groups

Time (Min)	VAS Pain Score				*p*-value	Interpretation
	Nylon		Stainless Steel			
	Mean	SD	Mean	SD		
1	0.1	0.31	0.24	0.63	0.0596	Not significant
2	0.43	0.65	1.19	1.28	0.00001	Significant
3	1	0.8	2.2	1.3	<0.00001	Significant
4	1.8	1.1	3.4	1.5	<0.00001	Significant
5	2.4	1.4	4.3	2	<0.00001	Significant
6	3.21	1.73	5.1	1.99	<0.00001	Significant
7	3.73	1.8	5.64	1.97	<0.00001	Significant
8	4.3	1.7	6	1.9	<0.00001	Significant
9	4.8	1.6	6.4	2.1	0.000085	Significant
10	5	2	6	2	0.044492	Significant
11	5.9	1.6	6.4	2.3	0.156453	Not significant
12	6	1.5	6.1	2.4	0.448224	Not significant
13	6.5	1.5	4	0	0.003338	Significant
14	6.7	1.6	4	0	0.004355	Significant
15	6.4	1.8	4.3	0.5	0.035577	Significant
16	6.4	1.9	5	0	0.11776	Not significant
17	6	2	5	0	0.142953	Not significant
18	6	1.8	7.3	0.9	0.164762	Not significant
19	6	2	6	0	0.350768	Not significant
20	5	1.6	6	0	0.217665	Not significant

VAS – visual analog Scale score, SD – standard deviation, p = >0.05



Beyond the material softness, the design of the nylon/polyester finger trap may also contribute to its comfort profile. The braided tubular structure creates a broader surface area in contact with the skin, distributing traction forces more evenly around the circumference of the finger. This mechanical property likely reduces point pressure and shear, thereby minimizing discomfort during loading. This principle mirrors the force-dispersing behavior of bamboo finger traps,[5] where a similar design resulted in lower VAS pain scores compared to stainless steel. The present study's finding of no significant difference in pain scores beyond 15 minutes further supports the idea that material composition alone does not fully determine comfort; rather, structural design and load distribution play a critical role in user tolerance over time.

Despite the positive findings, this study has several limitations. The study population was limited to hospital staff, which may not fully represent the general patient population. This study's use of hospital staff volunteers, including orthopedic personnel, may have introduced selection and detection bias due to familiarity with traction procedures. Future studies should include participants with no prior clinical exposure to improve generalizability. Convenience sampling was used rather than randomization, which may introduce selection bias. Additionally, the study did not assess the long-term durability or patient satisfaction beyond the initial test period. Future research should compare the performance of homemade nylon/polyester finger traps with commercially manufactured nylon finger traps to provide further insights into their effectiveness and cost-efficiency.

CONCLUSION

This study demonstrated that homemade nylon/polyester finger traps offered a more comfortable alternative to stainless-steel finger traps, as evidenced by significantly lower VAS pain scores, particularly within the first ten minutes of use. The homemade nature of the nylon/polyester trap not only enhanced patient comfort but also offered potential cost-effectiveness. Given the low cost of materials and the simplicity of assembly, this device may provide a practical, affordable option for healthcare settings, particularly those with limited resources.

However, while the potential for cost savings is clear, this study did not directly measure or calculate production costs. Future research should formally evaluate the cost-effectiveness of homemade nylon/polyester finger traps, including a direct comparison with commercially manufactured nylon finger traps.

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STATEMENT OF AUTHORSHIP

Both authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

KSC: Conceptualization, Methodology, Software, Formal analysis, Investigation, Data Curation, Writing – original draft preparation, Visualization, Project administration, Funding acquisition; **JDS:** Validation, Resources, Writing – review and editing, Supervision.

AUTHOR DISCLOSURE

Both authors declared no conflict of interest.

DATA AVAILABILITY STATEMENT

The datasets generated and analyzed in this study are included in the published article.

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None.

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The Philippine Journal of Orthopaedics

CASE REPORT

Trochanteric Digastric Approach for Chronic Hip Dislocation in a 31-year-old Man

Niko Augustine R. Abella, MD[1] and Benjamin Chua III, MD, FPOA[1,2]

[1]*Department of Orthopedics, Philippine Orthopedic Center, Quezon City, Philippines*
[2]*Department of Orthopedics, Far Eastern University-Nicanor Reyes Medical Foundation, Quezon City, Philippines*

ABSTRACT

Chronic traumatic hip dislocations are rare, and there is little literature to guide management. Challenges include achieving adequate exposure, preserving vascular supply, and maintaining joint stability. This case shows the successful treatment of a chronic posterior hip dislocation in a 31-year-old man who presented six weeks after a road traffic accident with a 3.5 cm leg length discrepancy. The surgery was performed at eight weeks post-injury, due to restrictions posed by COVID-19. We used the trochanteric digastric hip osteotomy to optimize joint exposure, aid in reduction, and preserve the vascularity of the femoral head. Intraoperatively, significant intra-articular fibrosis was identified and excised, and the hip was successfully reduced. The patient attained a Harris Hip Score of 90 in 12 weeks, with no evidence of osteonecrosis after two years of follow-up. This case demonstrates that the trochanteric digastric hip osteotomy is an effective approach for managing chronic hip dislocations, preserving femoral head vascularity, and restoring function with minimal complications.

Keywords. chronic hip dislocation, trochanteric osteotomy, traumatic hip dislocation, open reduction, femoral head vascularity, orthopedic surgery

INTRODUCTION

In developed countries, chronic traumatic hip dislocations are rare, making literature on the topic scarce. When treating these injuries, the main goals are to achieve reduction through adequate exposure, and to prevent avascular necrosis by preserving vasculature. Even when post-traumatic arthritis or osteonecrosis occurs, patients often retain improved hip function, allowing for future interventions such as total hip replacement or arthrodesis.[1]

Delayed treatment results in significant intracapsular fibrosis and muscle contracture, making it difficult to achieve a stable and anatomically congruent joint.[2] A delay of 12 hours results in a 22 to 52% chance of femoral head avascular necrosis.[3] Even the open reduction itself can cause avascular necrosis in as many as 52% of cases. Intraoperative assessment of the femoral head and preservation of joint vasculature is crucial.

There are several possible approaches to a dislocated hip. Posterior approaches allow direct access for posterior dislocations but typically disrupt the short external rotators and risk damage to the medial femoral circumflex artery. Anterior approaches allow direct access for anterior dislocations, offering good exposure while avoiding the posterior vasculature. Minimally invasive techniques, such as the direct anterior approach, while providing better cosmesis, faster recovery, and lower dislocation rates, do not provide adequate

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Corresponding author: Niko Augustine R. Abella, MD
Resident-Medical Officer III,
Department of Trauma and Orthopedic Surgery
Philippine Orthopedic Center,
78-A Maria Clara St., Sta. Mesa Heights,
Quezon City, 1114 Metro Manila, Philippines
E-mail: nikoabellamd@gmail.com
ORCiD: https://orcid.org/0009-0008-7342-2622

exposure in chronic cases and risk injury to the lateral femoral cutaneous nerve.[4,5]

Since Ganz's detailed anatomical studies on hip blood supply and his technique for safe 'Surgical Dislocation of the Adult Hip,' the trochanteric flip osteotomy has increasingly been utilized for acute and chronic fracture-dislocations.[6] This approach provides 360-degree exposure of the femoral head and acetabulum while preserving the medial femoral circumflex artery (MFCA), minimizing the risk of avascular necrosis.[1,6] Its versatility makes it suitable for complex reconstructions, femoral head fractures, and certain deformities. The osteotomy, however, introduces potential complications, including nonunion, malunion, and hardware failure.[7] Additionally, patients may experience a longer recovery period due to the time required for osteotomy healing and the risk of transient or permanent abductor weakness.

Given the chronic nature of the dislocation in our case, the trochanteric digastric approach was selected. We explored this approach that prioritizes preserving hip vascularity and native femoral head integrity without disturbing the short external rotators.

CASE

Here, we present a 31-year-old man who arrived six weeks after a road traffic accident with a chronic hip dislocation (Figures 1 and 2).

The delay was due to COVID-19-related surgical protocols. The patient had a 3.5 cm leg length discrepancy, intact ankle and toe dorsiflexion, and no neurovascular deficits. Surgery was performed at eight weeks post-injury, using the digastric hip osteotomy approach for enhanced exposure and reduction.

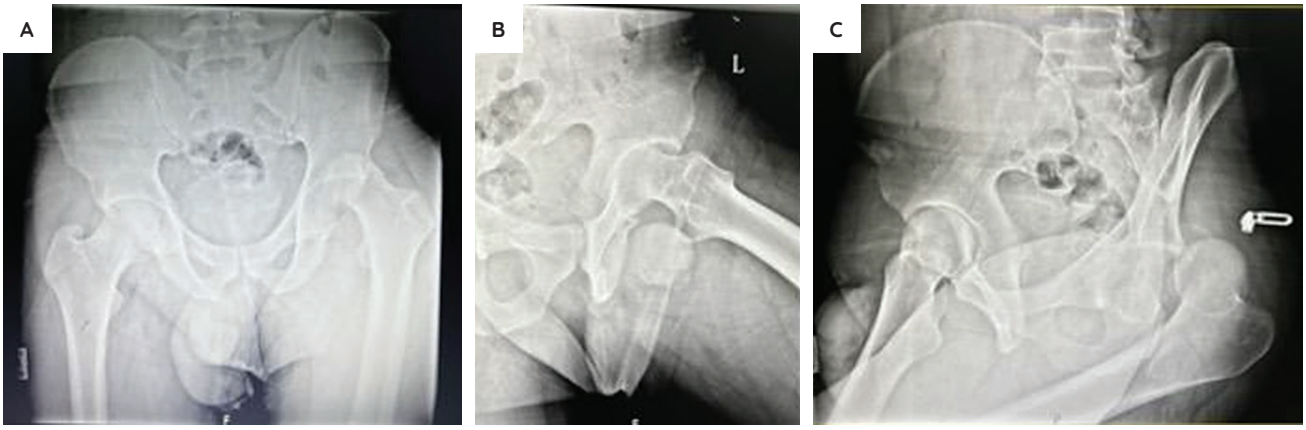

Figure 1. Pre-operative radiographs—anteroposterior (AP) pelvis **(A)**, lateral hip **(B)**, and Judet oblique view **(C)**—obtained on the day of consultation in the Emergency Room, 6 weeks post-injury.

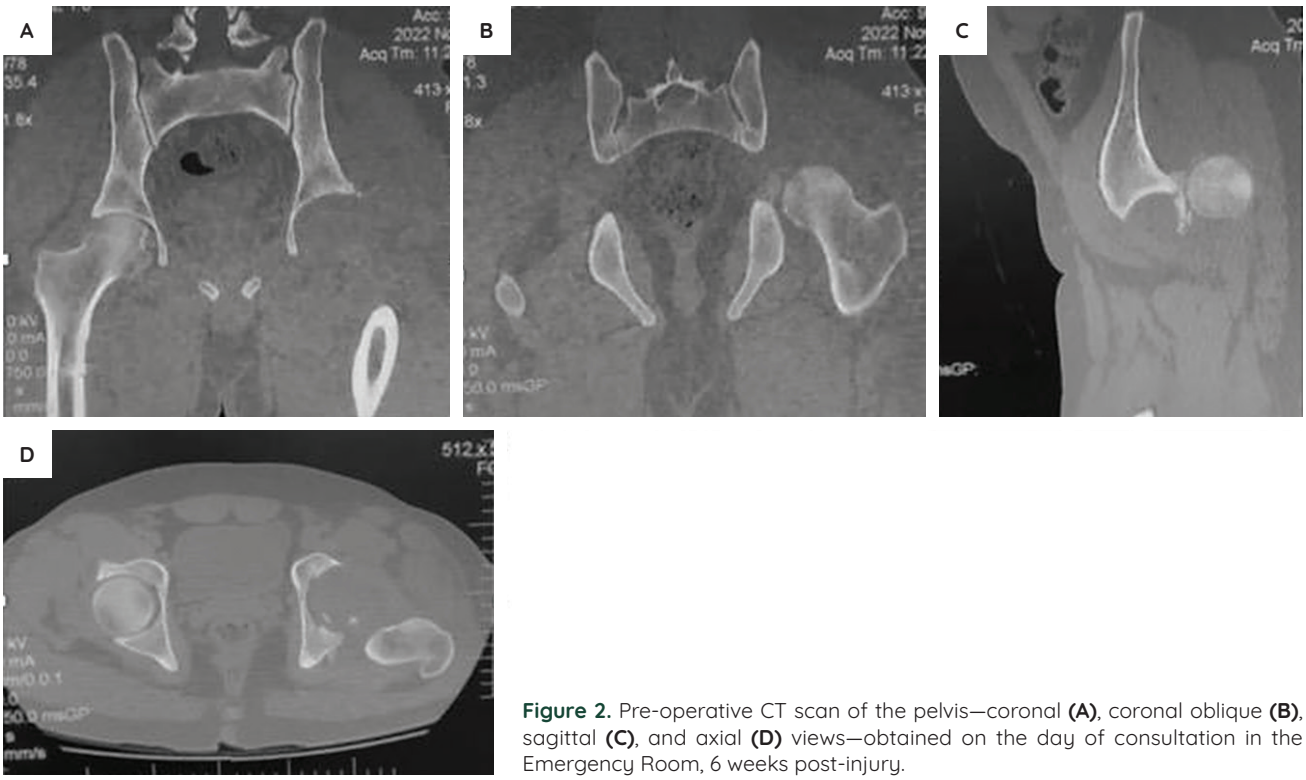

Figure 2. Pre-operative CT scan of the pelvis—coronal **(A)**, coronal oblique **(B)**, sagittal **(C)**, and axial **(D)** views—obtained on the day of consultation in the Emergency Room, 6 weeks post-injury.

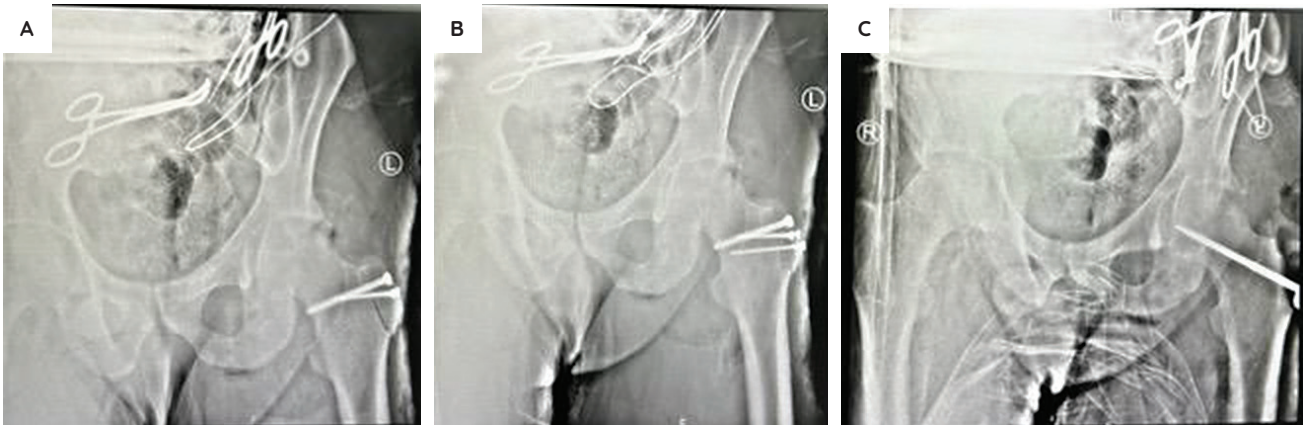

Figure 3. Intra-operative radiographs—Judet oblique **(A)**, iliac oblique **(B)**, and anteroposterior pelvic view **(C)**—obtained on the day of surgery, 8 weeks post-injury.

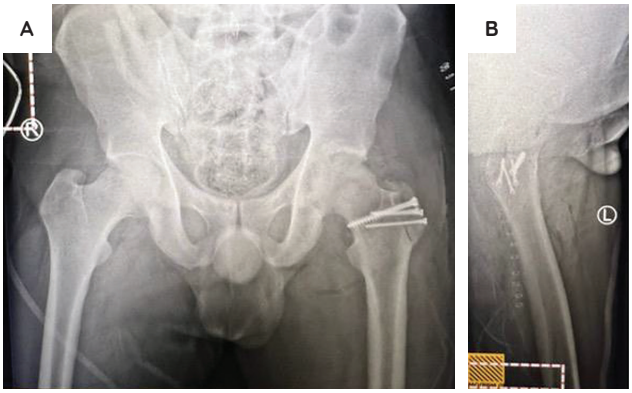

Figure 4. Post-operative radiographs—anteroposterior **(A)** and left lateral hip view **(B)**—taken on the day of surgery, 8 weeks after the initial injury.

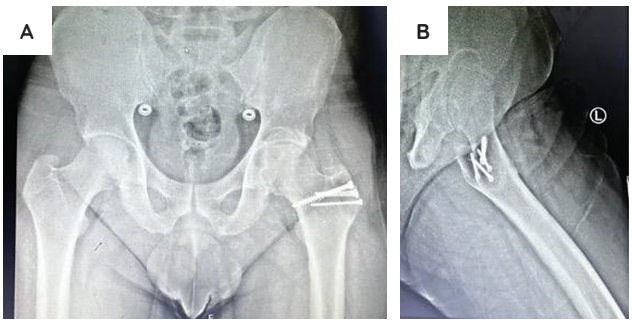

Figure 5. Post-operative radiographs—anteroposterior **(A)** and left lateral hip view **(B)**—taken on the day of surgery and at 1 year postop.

METHOD

Surgical approach/method

We followed the technique depicted in Ganz's original publication in 2001.[6]

1. **Patient positioning:** The patient was positioned securely in the lateral decubitus position.
2. **Incision:** The incision started 10–15 cm proximal to the trochanter and extended 10–15 cm distally.
3. **Soft tissue dissection:** The approach delineated the interval between the gluteus maximus and medius. The iliotibial tract was longitudinally split to mobilize the gluteus medius fascia, exposing the gluteus maximus muscle belly posteriorly.

Intraoperatively, vascular landmarks, such as the trochanteric anastomosis (which was cauterized) and the inferior gluteal artery branch, assisted in identifying the external rotator anatomy.

4. **Trochanter osteotomy:** The osteotomy was marked from the trochanter tip to the base of the vastus tubercle. A portion of the gluteus medius tendon remained temporarily attached to prevent retinacular vessel injury.

The trochanteric osteotomy (up to 1.5 cm thick) was performed with an oscillating saw, exiting just anterior to the most posterior insertion of the gluteus medius.

5. **Further mobilization:** The gluteus minimus muscle was mobilized from the iliac wing, and the vastus lateralis was incised distally from the vastus tubercle to facilitate periosteal mobilization. Flexion and external rotation of the hip improved anterior exposure for mobilizing the gluteus minimus along the superior capsule.

An anterolateral incision along the femur's long axis avoided injury to the deep branch of the medial femoral circumflex artery. The anteroinferior capsule was incised to visualize the labrum.

6. **Debridement and soft tissue release:** Fibrous tissue obstructing reduction was removed. Soft tissue contractures were released.

Intraoperatively, significant fibrous tissue within the acetabulum was noted before successful joint reduction. The cartilage on the acetabulum was intact. The femoral head exhibited good sphericity without chondral damage. No loose bodies were found. The joint was washed copiously with saline (Figures 3-5).[9]

Figure 6. Functional status at 1 year post-op: The patient was able to stand and ambulate without gait deficits and could perform a full squat without limitations.

Table 1. Post-operative timeline showing weight-bearing status and exercises performed

Timeline	Weight-bearing status	Exercise and rehabilitation
1 week	Toe-touch weight bearing	Ankle pumps, isometric quadriceps and gluteal sets
3 weeks	25% partial weight bearing (PWB)	Gentle range of motion (ROM) exercises, hip abduction/adduction
6 weeks	50% PWB	Progressive resistive exercises, stationary cycling
8 weeks	75% PWB	Increased resistance training, balance exercises
10-12 weeks	Full weight bearing as tolerated	Gait training, proprioceptive exercises and functional training

Table 2. Comparison of the operated hip with the contralateral hip at 12 weeks

Parameter	Operated hip	Contralateral hip	Outcome
Range of Motion (ROM)	120° flexion, 30° extension, 40° abduction	120° flexion, 30° extension, 40° abduction	Almost comparable outcomes noted
Manual Muscle Testing (MMT)	Grade 5	Grade 5	Symmetrical strength noted
Pain Scale (NRS)	0/10	0/10	No residual pain

Postoperative course

The patient underwent structured physical therapy including strengthening, range of motion exercises, and gait retraining exercises. The range of motion exercises and strengthening focused on open kinematic chain exercises during the post-operative period. The patient began toe-touch weight-bearing status for the first week, followed by partial weight-bearing of 25% for the second to fourth weeks, 50% weight-bearing at one month, and subsequently progressed as tolerated (Table 1).

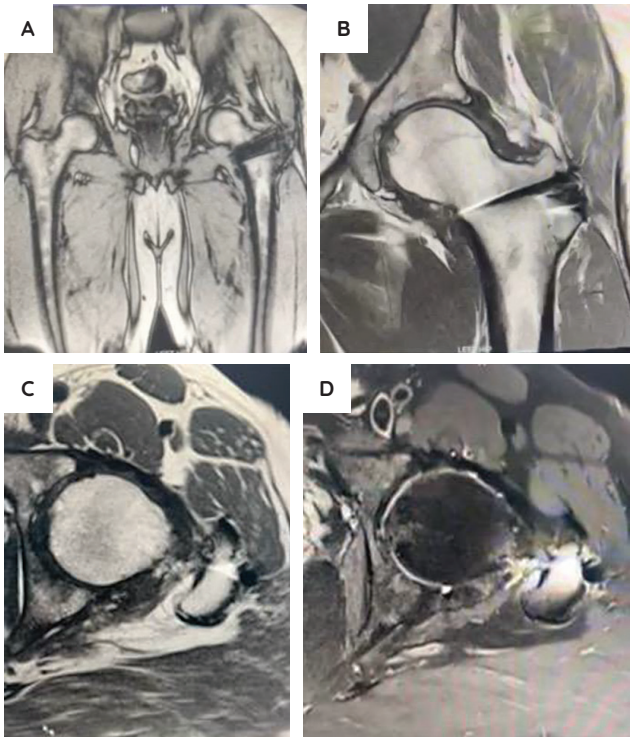

Figure 7. T1-weighted MRI of the pelvis showing no lysis of the left femoral head or the fixation over the greater trochanter: coronal **(A)** and sagittal **(B)** views taken 1 year post-op; axial cuts **(C and D)** similarly demonstrate no evidence of lysis at 1 year postop.

Notably, the patient regained pre-injury ambulatory status without a limp by 12 weeks postoperatively, achieving a Harris Hip Score (HHS) of 90. The range of motion was comparable to the contralateral hip, with flexion of 120°, extension of 20°, and abduction of 40°. Manual muscle testing showed an MMT grade of 5/5 across all major muscle groups. The patient demonstrated no Trendelenburg gait and reported a pain score of 0/10 (Table 2) (Figure 6).

Magnetic resonance imaging of the affected femoro-acetabular joint did not show evidence of osteonecrosis at one and two years post-operatively (Figures 7 and 8).

DISCUSSION

The trochanteric digastric osteotomy was effective in treating a chronic hip dislocation in a 31-year-old man.

The trochanteric digastric approach offers several advantages over other hip surgical techniques. Unlike the DAA, which provides limited exposure and has a steep learning curve, the digastric approach allows 360-degree access to the femoral head and acetabulum, crucial for addressing complex hip deformities and chronic dislocations. This enhanced exposure facilitates meticulous debridement, better visualization of intra-articular structures, and precise reduction, which is often challenging in anterior approaches. It avoids dividing external rotators and preserves the MFCA.[6]

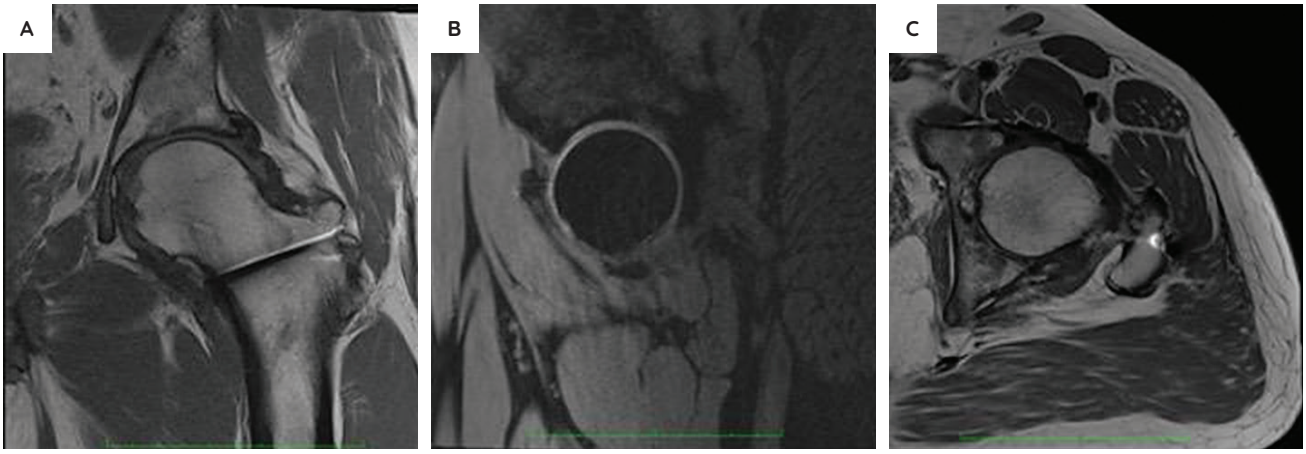

Figure 8. T1-weighted MRI of the pelvis [coronal cut **(A)**] and axial cuts on T2-weighted **(B)** and T1-weighted **(C)** sequences, taken 2 years postoperatively, showing no lysis of the left femoral head and no evidence of avascular necrosis.

Traumatic dislocations typically spare the posterior vessels if the obturator externus muscle remains intact. While a direct posterior approach risks direct injury to the MFCA, cadaveric studies reveal that modifications to this approach help avoid this. Posterolateral approaches, with short external rotator tenotomy and capsulotomy designed to spare the medial femoral circumflex artery (MFCA), reduce vascular insult.[7] Additionally, this approach preserves abductor muscle function, which is essential for maintaining hip stability and gait mechanics. The deep branch of the MFCA primarily supplies the superior area of the femoral head via two to four superior retinacular vessels. Maintaining this blood supply is vital for clinical success, mandating anterior capsulotomy.

The posterior approach also carries a higher risk of posterior re-dislocation, whereas the trochanteric digastric approach provides superior stability due to the controlled and anatomical repositioning of the osteotomized fragment.

Performing an osteotomy of the greater trochanter introduces its own set of challenges, such as nonunion, malunion, and hardware failure. Patients may also face a prolonged recovery period due to the time required for osteotomy healing and the potential for transient or permanent abductor weakness.[4] These factors highlight the importance of meticulous pre-operative assessment and a structured rehabilitation protocol to optimize functional outcomes.

Ganz's study on 213 hips over seven years, including 19 patients who underwent intertrochanteric osteotomies, verifies femoral head perfusion intraoperatively, with no subsequent avascular necrosis. This technique minimizes morbidity and treats various conditions effectively.[6]

Regardless of approach, thorough hip joint debris clearance and irrigation are crucial before reduction.[3]

CONCLUSION

In our case of a posterior hip dislocation that went untreated for two months, the trochanteric digastric approach proved a safe surgical option, preserving femoral head vascularity, and achieving favorable outcomes with no radiographic evidence of femoral head avascular necrosis after two years of follow-up.

ETHICAL CONSIDERATION

Patient consent form was obtained before manuscript submission.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

NARA: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing – original draft preparation, Writing – review and editing, Visualization, Supervision, Project administration; **BC:** Conceptualization, Investigation, Resources, Data Curation, Writing – original draft preparation, Visualization, Supervision, Project administration.

AUTHOR DISCLOSURE

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CASE REPORT

Surgical Treatment of Scoliosis in Patients with Osteogenesis Imperfecta: A Case Report

Bienvenido Leo Antonio M. Caro, MD, FPOA,[1] Anchelle Grace O. Ho, MD,[2]
Samuel Arsenio M. Grozman, MD, FPOA, FPSS,[1] Anne Kathleen B. Ganal-Antonio, MD, FPOA, FPSS[1]

[1]*Spine Division, Department of Orthopedics, University of the Philippines-Philippine General Hospital*
[2]*Department of Orthopedics, University of the Philippines-Philippine General Hospital*

ABSTRACT

Patients with osteogenesis imperfecta (OI) face many challenges, including skeletal deformities and repeated extremity fractures. Spinal deformities in patients with OI are especially challenging for spine surgeons because of poor bone stock and rigid curves, often necessitating surgical treatment.

This case report presents two OI patients with scoliosis managed in our institution. Patient A was a woman in her 20s, while patient B was in her 30s. Both had progression of curves past skeletal maturity and underwent pre-operative bisphosphonate therapy before deformity correction and instrumentation. Due to acceptable bone density pre-operatively, non-fenestrated pedicle screws without cement augmentation were utilized for both patients. We did not encounter implant failure, junctional kyphosis, or pseudoarthrosis. Despite a loss of correction of 3% (mid-thoracic) and 9% (lumbar) for patient A and 2% (thoracic) and 6% (thoraco-lumbar) for patient B, both patients did not return to pre-operative measurements after 1 year of follow-up. They were also ambulatory and returned to employment postoperatively.

Keywords. scoliosis, osteogenesis imperfecta, pedicle screws, bisphosphonates

INTRODUCTION

Osteogenesis imperfecta (OI) is a rare disorder associated with collagen-related syndromes that may present in many ways. Patients with OI have fragile bones and are susceptible to extremity fractures, skeletal deformity, and typically have short stature. Historically, OI was classified by Sillence and Danks into 4 types,[1] but the classification was later expanded by Cole et al. to 11 types.[2] The types are classified according to four salient features: skeletal dysplasia, dentinogenesis imperfecta, bluish sclerae, and otosclerosis. Type III OI usually presents with early onset scoliosis, triangular facies, frontal bossing, basilar invagination, and extremely short stature. These types usually warrant pinning of both femurs prophylactically or as treatment for pathologic fractures. Type XI, on the other hand, presents with bone dysplasia, ligamentous laxity, and scoliosis. Patients typically have normal stature and no frontal bossing.[2]

Patients with OI may present with scoliosis in 20 to 40% of cases. Bracing may play a role depending on the curve severity and age at diagnosis.[3] Surgery is indicated if the curve is greater than 40 to 50 degrees in skeletally mature patients or if the curve progresses significantly after skeletal maturity. In addition, iliopelvic fixation is warranted if there is more

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Corresponding author:
Bienvenido Leo Antonio M. Caro, MD, FPOA
Clinical Associate Professor, Spine Section,
Department of Orthopedics,
University of the Philippines-Philippine General Hospital,
Taft Avenue corner Padre Faura St., Ermita,
Manila, 1000 Metro Manila, Philippines
Tel. No.: (+632) 8554-8400
E-mail: bmcaro@up.edu.ph
ORCiD: https://orcid.org/0009-0005-2087-8747

than 10 degrees of pelvic obliquity.[4] If left untreated, patients may face balance issues and restrictive lung disease.[5]

The bone quality of these patients is expected to be poor, making surgery and fixation difficult. Pre-operative bisphosphonates have been used to prevent implant failure and future fracture risk.[6] But bisphosphonates must be discontinued at least 6 months before spinal fusion surgery to allow the spinal fusion mass to mature. Bisphosphonates prevent de novo bone formation and remodeling and may interfere with the postoperative course.[6]

Since bone stock is poor, implants have poor purchase and can pull out when using regular non-fenestrated pedicle screws. While bone cement has been used to augmented fenestrated screws, cement extravasation and cement emboli are still dreaded complications, which occur 12.7% and 5.4% of the time respectively.[7] Cement augmentation at the tips of non-fenestrated screws may provide subjective improvements in pain, but does not significantly improve postoperative activity levels.[8]

Given the absence of higher-level studies on managing scoliosis in patients with OI, best practices for preoperative treatment and implant fixation are still unclear.

This study aimed to evaluate the surgical management and outcomes of scoliosis in patients with OI using posterior spinal fusion with non-fenestrated pedicle screws: the achievable amount of correction, subjective improvements, and complications (if any).

CASE

Two patients with scoliosis associated with OI were treated in a tertiary government hospital. Patient A was a woman in her 20s diagnosed with OI type III because of the following features: (-) dentinogenesis imperfecta, (+) short stature, thoracolumbar kyphosis and scoliosis with pelvic obliquity >10 degrees, and frontal bossing (Figure 1). Birth and maternal, family, and social histories were all unremarkable. She first consulted at eight years old for extremity fractures and thoracolumbar spine asymmetry. She started bracing and bisphosphonate treatment (Pamidronate) with monthly infusions for the first six months, every other month for the next six months, then twice a month for the next two years.

Extremity fractures were initially immobilized conservatively but were eventually treated surgically because of fracture recurrences. She underwent pin fixation of the left femur in 2008, pin fixation of the right femur in 2010, and revision of the latter applied implant in the same year (Figures 2 and 3). After she had reached skeletal maturity, scoliotic curves progressed to greater than 40 degrees and was ambulatory only with a cane. Surgery was indicated to correct her spine deformity. Preoperative dual-energy x-ray absorptiometry (DEXA) revealed osteopenia (Table 1). She was referred to the endocrinology service, and she started Alendronate 70 mg/tab once a week for three months, with no repeat DEXA warranted. The surgery was postponed to approximately six months after completion of Alendronate treatment. The latest curve measurements before surgery were a 30-degree proximal thoracic curve, a 58-degree thoracic curve, and a 38-degree thoracolumbar/lumbar curve (Figure 4).

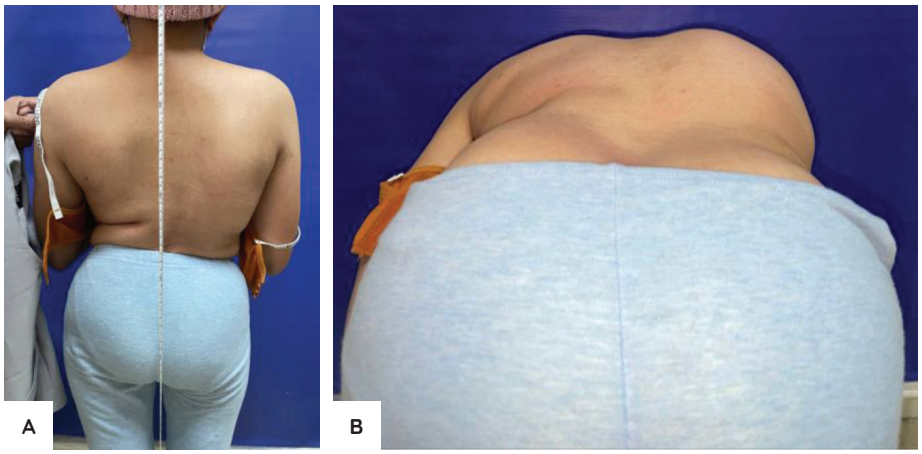

Figure 1. ***Patient A clinical pictures***. Standing gross pictures of patient with pelvic obliquity and grossly scoliotic curve more focused on the lumbar spine **(A)**. Forward bending test outlining direction of curves on both thoracic and lumbar sections of the spine **(B)**.

Table 1. Dual energy x-ray absorptiometry readings post treatment (prior to surgery)

	Patient A			Patient B		
	BMD (g/cm²)	T- score	Z- score	BMD (g/cm²)	T- score	Z- score
Lumbar spine (L1–L2)	0.877	-1.6	-1.6	1.164	1.2	1.2
Lumbar spine (L2–L4)	0.857	-1.9	-1.9	1.276	2.0	2.0
Right femoral neck	0.764	-1.4	-1.4	1.481	4.5	4.6
Left femoral neck	0.620	-2.6	-2.6	1.452	4.2	4.3

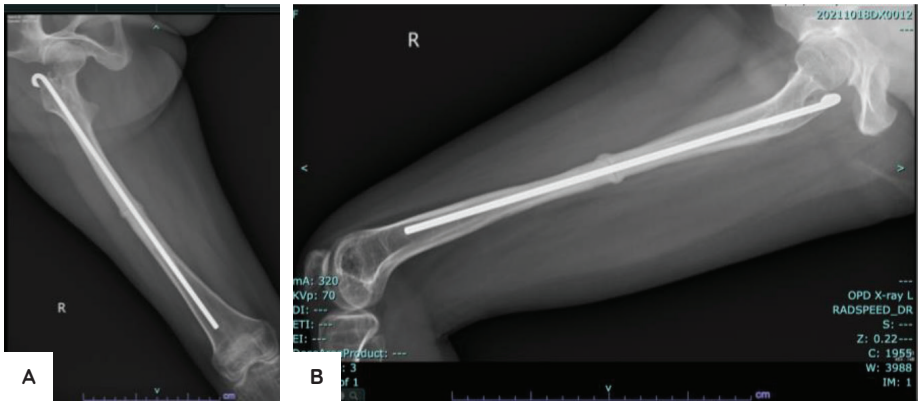

Figure 2. ***Right femur xrays (with fixation)***. Anteroposterior x-ray of the right femur showing healed pathologic fracture and adequately inserted implant **(A)**. Lateral x-ray of the right femur showing healed pathologic fracture and adequately inserted implant **(B)**.

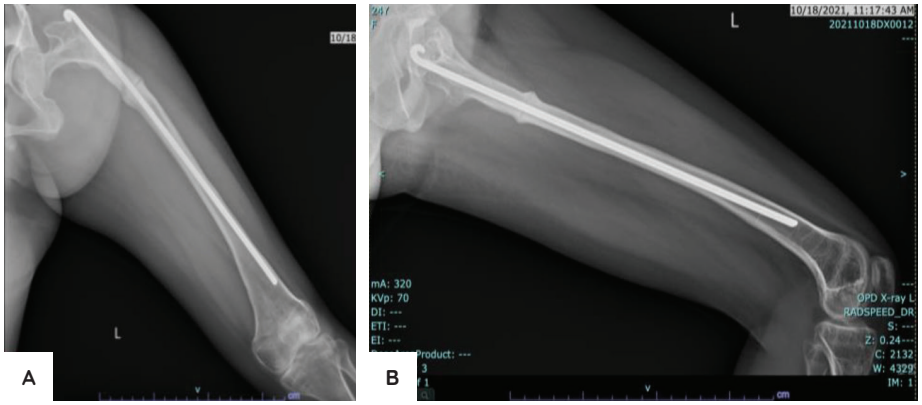

Figure 3. ***Left femur xrays (with fixation)***. Anteroposterior x-ray of the left femur showing healed pathologic fracture and adequately inserted implant **(A)**. Lateral x-ray of the left femur showing healed pathologic fracture and adequately inserted implant **(B)**.

Patient B was a woman in her early 30s diagnosed with OI type XI because of the following features: (+) scoliosis, (+) ligamentous laxity, pelvic obliquity <10 degrees, normal stature, (-) frontal bossing (Figure 5). She first consulted at 13 years of age and was advised bracing. She had recurrent lower extremity fractures, which were all managed conservatively with immobilization. There were no problems encountered with fracture healing. Pamidronate infusion was also started, infusing 1 mg/kg monthly for the first six months, then every other month for the next six months, then twice a month until three years were completed. Her curves also progressed after reaching skeletal maturity, prompting operative management.

Preoperative dual-energy x-ray absorptiometry (DEXA) showed normal findings (Table 1). The latest curve measurements before operation were: a 54-degree thoracic curve and a 64-degree thoracolumbar/lumbar curve (Figure 6).

For patient A, instrumentation was done from T6 to L5 with non-fenestrated pedicle screws and bilateral iliac screw fixation due to the noted pelvic obliquity. No cement augmentation was done. We used 15 monoaxial reduction-type and 2 polyaxial screws; the latter were chosen to facilitate rod application on the bilateral iliac screws. Screw sizes ranged from 5.0 to 5.5 mm in diameter and 35 to 40 mm in length. Brainlab navigation was used to verify screw trajectory before insertion. Full navigation was utilized in all steps for pedicle screw insertion in the T6 vertebra. We performed Smith-Petersen osteotomies on the apices of both curves, namely at T9 and L3. The curves were corrected via unilateral rod application and derotation. The contralateral rods were then applied, and the constructs tightened. To further improve correction, on the apices, the convex sides were compressed and the concave sides were distracted. Decortication was done, cross-links applied for rotational stability, and a bone graft was applied before closure. Total operative time was six hours, and total blood loss was estimated to be 1200 mL with three units of packed red blood cells (pRBC) transfused. Intraoperatively, the screws did not pull out. Postoperatively, there were no neurologic changes. Once discharged, the patient and her family decided to go to their hometown for recovery. We could not obtain immediate follow-up standing radiographs for two months, six months, the one year postoperatively (Figure 7, Table 2). Despite the loss of correction on subsequent follow-ups (2.1% loss of thoracic correction and 10.6% loss of lumbar correction), the curves did not revert to pre-operative measurements, and no other surgical complications were encountered, such as surgical site infection, implant failure, junctional kyphosis, or pseudoarthrosis. The patient became ambulatory without

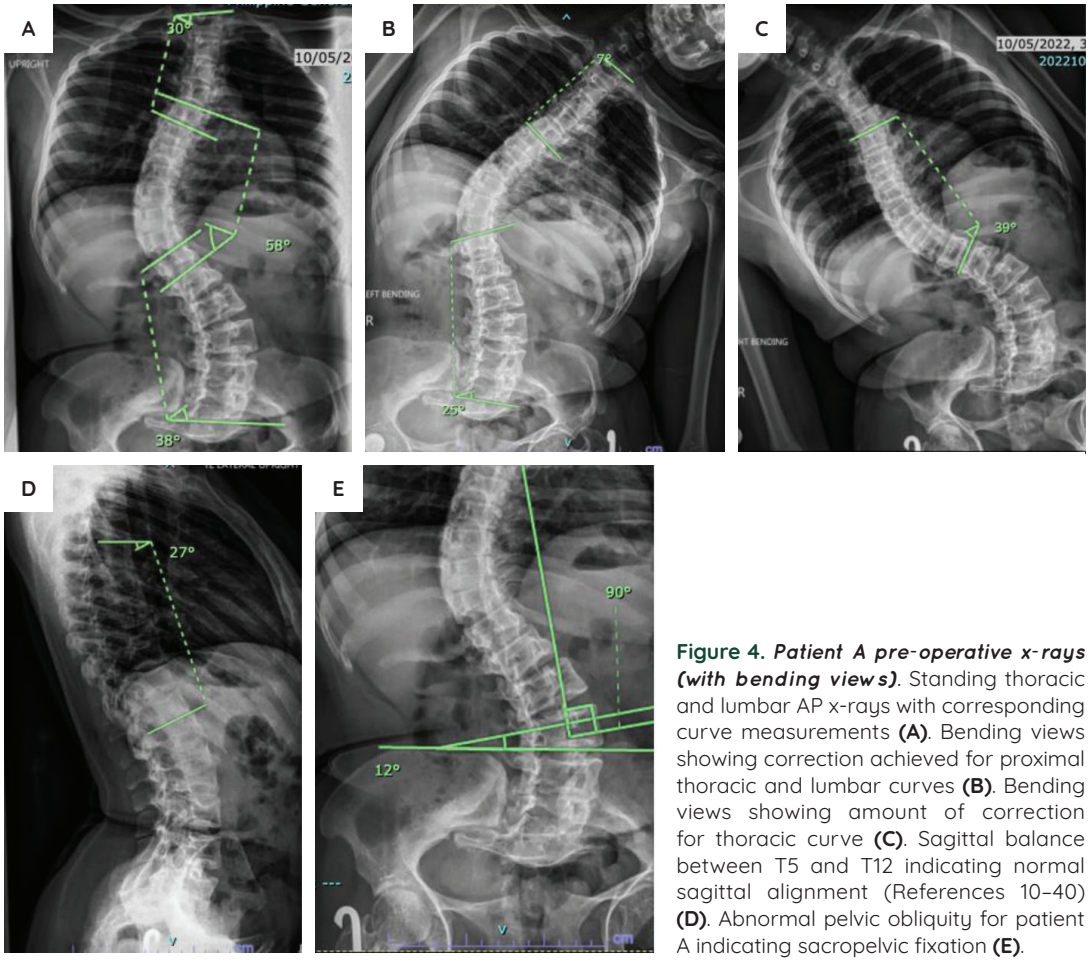

Figure 4. ***Patient A pre-operative x-rays (with bending views)***. Standing thoracic and lumbar AP x-rays with corresponding curve measurements **(A)**. Bending views showing correction achieved for proximal thoracic and lumbar curves **(B)**. Bending views showing amount of correction for thoracic curve **(C)**. Sagittal balance between T5 and T12 indicating normal sagittal alignment (References 10–40) **(D)**. Abnormal pelvic obliquity for patient A indicating sacropelvic fixation **(E)**.

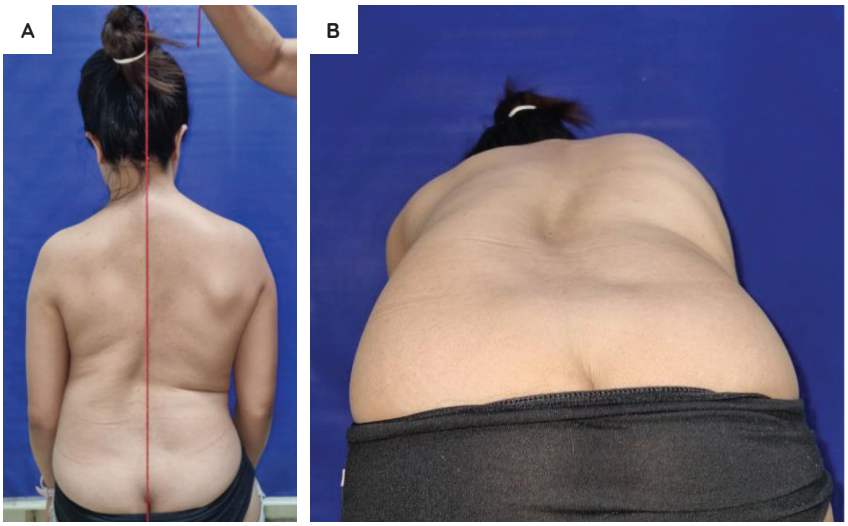

Figure 5. ***Patient B clinical pictures***. Standing clinical picture for patient B showing the central sacral vertical line in relation to the clinical curve **(A)**. Forward bending test outlining direction of curves on both thoracic and lumbar sections of the spine **(B)**.

any assistive device. The final corrections achieved were 31.9% and 54.5% for thoracic and lumbar curves, respectively. Visual analog scale scores were 9/10 immediately postoperatively, 5/10 at six months, and 1/10 at one year. No repeat DEXA scans were warranted. She was able to resume baking and selling pastries.

Patient B underwent instrumentation from T5 to S1 using non-fenestrated pedicle screws without cement augmentation. We used 16 screws, all 5.5 mm in diameter and 40 mm in length, six of which were polyaxial. Pedicle screw tracts were created freehand, and Brainlab navigation was used to verify screw trajectory before insertion. We performed a Smith-

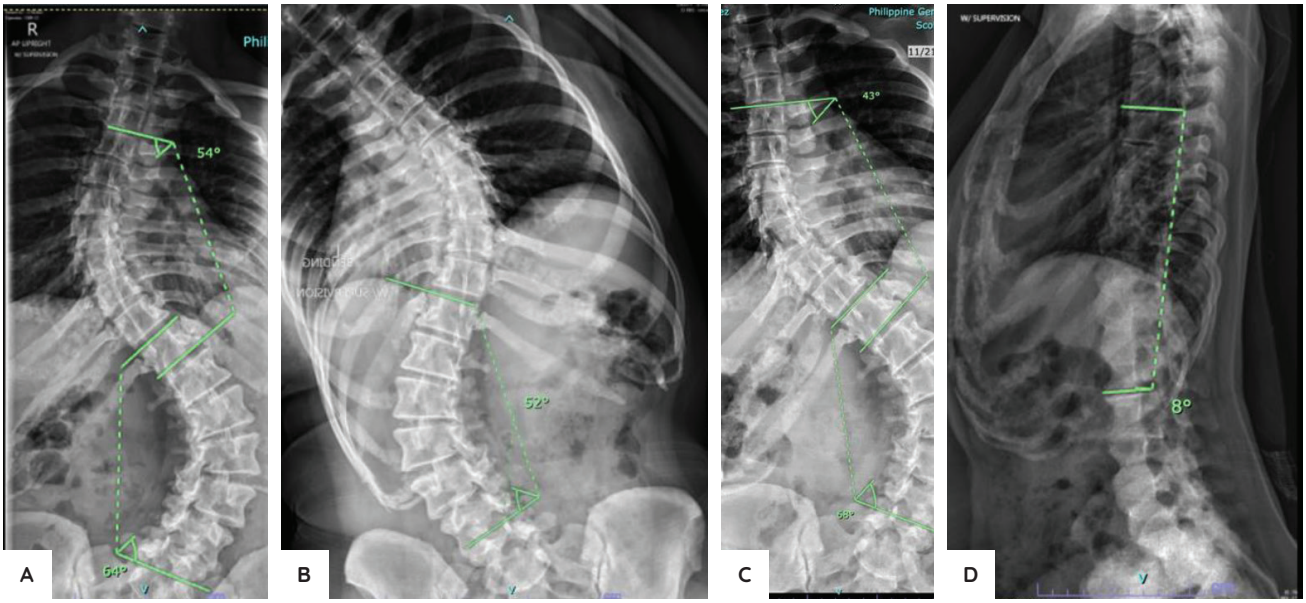

Figure 6. ***Patient B pre-operative x-rays (with bending views)***. Standing thoracic and lumbar AP x-rays showing curve measurements for thoracic and lumbar curves **(A)**. Bending views showing amount of correction achieved for the lumbar curve **(B)**. Bending views showing amount of correction achieved for the thoracic curve **(C)**. Lateral x-ray showing below-normal sagittal alignment (Reference: 10–40 degrees) indicating a hypokyphotic spine **(D)**.

Petersen osteotomy on L3 (apex), followed by derotation. The contralateral rod was inserted and fixed. To further improve correction, at the apex, the convex sides were compressed and the concave sides were distracted. Decortication was done, cross-links applied for rotational stability, and bone graft was applied before closure. The surgical time was 5 hours and 30 minutes, with blood loss estimated at 1150 ml. Intraoperatively, the screws did not pull out. Postoperatively, there were no neurologic changes. Serial radiographs showed a loss of correction of 2.6% for the thoracic and 6.3 % for the lumbar (Figure 8, Table 3). There were no noted complications such as surgical site infection, implant failure, junctional kyphosis, or pseudoarthrosis. Final corrections achieved were 33.3% and 37.5% for the thoracic and lumbar curves, respectively. Pain score (numerical rating scale) was 6/10 at two months, 5/10 at three months, 3/10 at six months, and 1/10 on the last follow-up.

As described, both patients had unremarkable post-operative courses and resumed normal activities beyond six months postoperatively. This was evident even before the patients' one-year follow-ups. Hardware failure or junctional kyphosis did not occur despite loss of correction. Both patients were also ambulatory without any assistive devices. Both patients signed journal-provided consent forms before manuscript and protocol writing.

DISCUSSION

Osteogenesis imperfecta (OI) patients with frequent fractures, episodes of pain, and poor bone mineral density are indicated to undergo bisphosphonate, whether intravenously (e.g., Pamidronate) or orally (e.g., Alendronate).[8]

Intravenous bisphosphonates can be given for years, beginning once monthly, followed by twice monthly.[1] Oral bisphosphonates may also be given to adult patients with OI when indicated. There are no significant differences when comparing oral or intravenous bisphosphonate treatments in terms of fracture frequency and bone mineral density.[9]

With the progression of the main curves of both patients beyond 40 degrees, surgical management was indicated.[10,11] Upper instrumented vertebrae of both patients were selected based on the recommendation to fuse one vertebra above the endpoints of the Cobb measurement (end vertebra). It was T6 for Patient A, and T5 for patient B. Lower instrumentation included the pelvis for patient A due to pelvic obliquity (Figure 4), while the lower instrumented vertebra was S1 for patient B, since it was the vertebra nearest where the central sacral vertical line (CSVL) intersected or was medial to the pedicle outline.[11]

Given the patients' poor bone quality, cement augmentation was a point of contention. While cement augmentation provides higher pull-out strength, cement extravasation and cement emboli can still occur.[6] Adding cement to fixation with non-fenestrated screws yields subjective improvements in pain, but no significant differences in terms of curve correction and fusion rates in OI patients.[7]

With our choice of non-fenestrated screws without cement, we achieved 31.9% thoracic and 54.6% lumbar correction for patient A, and 33.3% thoracic and 37.5% lumbar correction for patient B (Tables 2 and 3). Possible complications when treating scoliosis in OI patients are hardware failure, surgical site infection, pseudoarthrosis, and proximal junctional

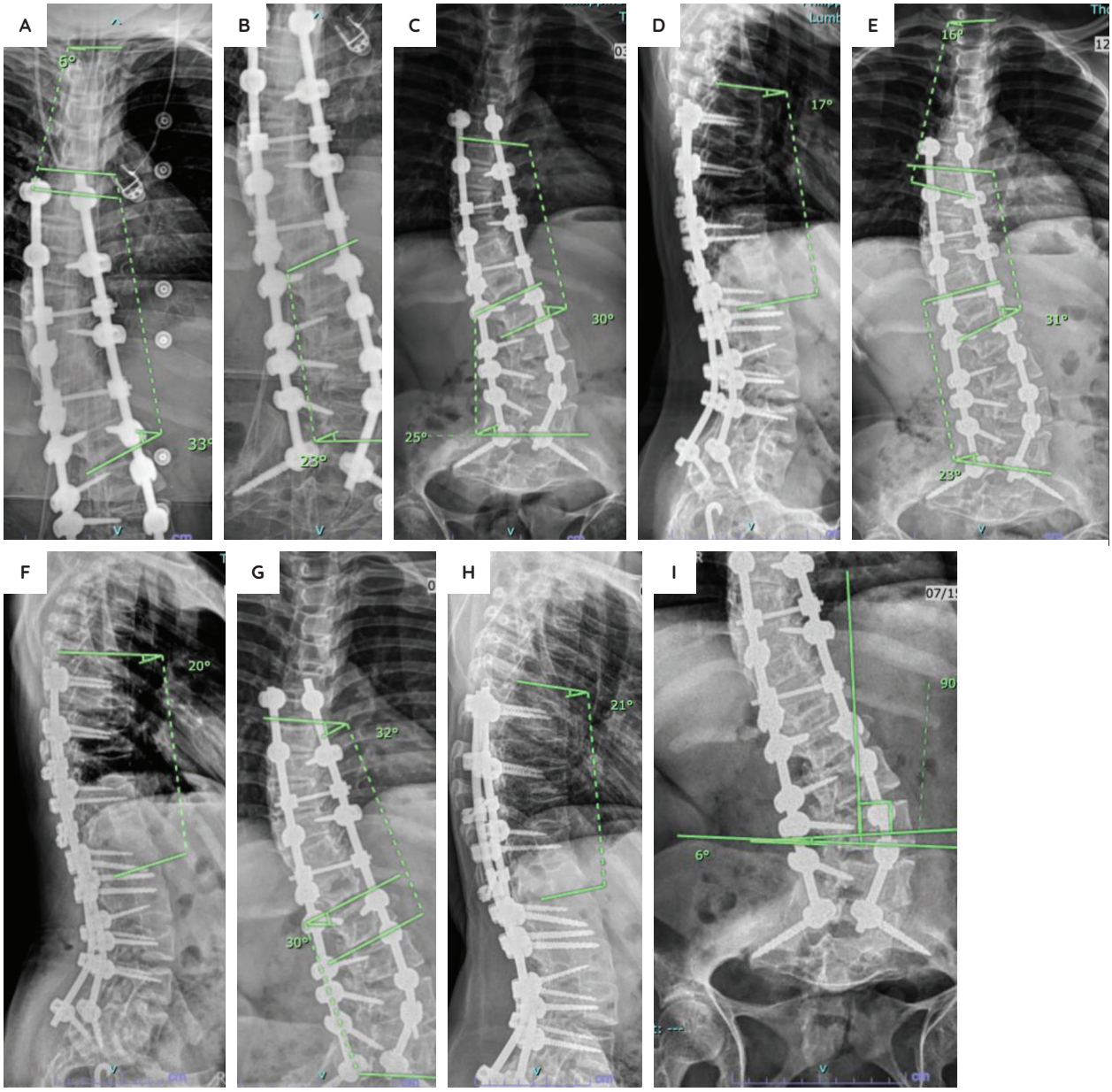

Figure 7. ***Patient A postoperative radiographs***. Postoperative AP xrays of patient A **(A and B)**. Standing AP and lateral xrays of Patient A two months postoperatively, with intact fixation and no screw pullouts **(C and D)**. Standing AP and lateral xrays of Patient A six months postoperatively showing loss of correction of the thoracic curve of 1 degree and kyphosis by 3 degrees but the latter still within normal limits (10–40 degrees) **(E and F)**. Standing AP and lateral xrays of Patient A one year post-operatively showing total loss of correction of the thoracic curve of 2 degrees and kyphosis by 1 degree but the latter still within normal limits **(G and H)**. Signs of fusion are also seen. Measurement of pelvic obliquity one year postoperatively within normal limits (<10 degrees) **(I)**.

Table 2. Pre-operative and postoperative curve measurements for patient A

	Standing	Bending	Predicted	Post-op standing				Correction
				2 weeks	2 months	6 months	12 months	
Thoracic (degrees)	47	7	85.1%	31 (34%)	30	31	32	31.9%
Thoracolumbar / lumbar (degrees)	66	25	62.1%	23 (65.1%)	25	23	30	54.5%
Sagittal alignment (T5–T12) (degrees)	17			N/A (Prone Xray)	17	20	21	

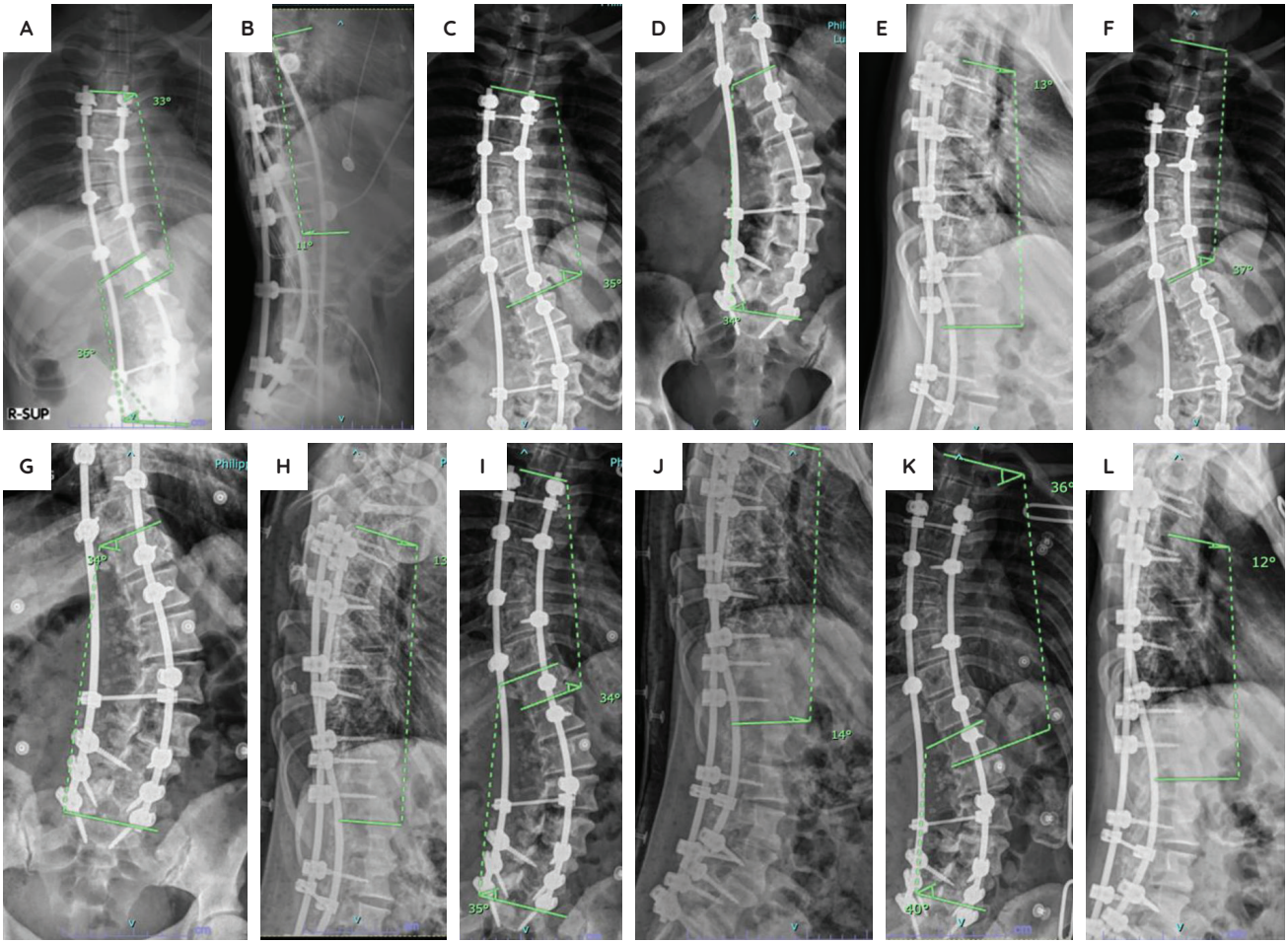

Figure 8. ***Patient B postoperative radiographs***. Standing AP and lateral xrays of Patient B two weeks postoperatively, with intact fixation and no screw pullouts **(A and B)**. Standing AP and lateral xraysof Patient B one month postoperatively showing loss of correction of the thoracic curve of proximal thoracic curve by 2 degrees, maintained thoracolumbar/lumbar curve, and an increase of kyphosis by 2 degrees, but still within normal limits (10–40 degrees) **(C, D, E)**. Standing AP and lateral xrays of Patient B three months postoperatively showing loss of correction of the thoracic curve of proximal thoracic curve by 4 degrees, maintained thoracolumbar/lumbar curve, and kyphosis within normal limits **(F, G, H)**. Standing AP and lateral xrays of Patient B six months postoperatively maintained correction of the proximal thoracic curve, thoracolumbar/lumbar curve, and kyphosis **(I and J)**. Standing AP and lateral xrays of Patient B 12 months postoperatively showing loss of correction of the proximal thoracic curve by 3 degrees and thoracolumbar/lumbar curve by 4 degrees, and maintained kyphosis **(K and L)**.

Table 3. Pre-operative and postoperative curve measurements for patient B

	Standing	Bending	Predicted	Post-op (2 weeks)	Post-op standing				Correction
					1 month	3 months	6 months	12 months	
Thoracic (degrees)	54	43	20.3%	33 (38.9%)	35	37	34	36	33.3%
Thoracolumbar / lumbar (degrees)	64	52	18.8%	36 (43.8%)	34	34	35	40	37.5%
Sagittal alignment (T5–T12) (degrees)	8			11	13	13	14	12	

kyphosis.[11,12] Fortunately, these didn't occur in our patients through serial radiographic monitoring at 2 weeks, 1 month, 3 months, 6 months, 9 months, 1 year, and 2 years postoperatively. Despite the initial loss of correction, fusion was achieved for both cases. None of the curves returned to the pre-operative measurements and sagittal balance, as evidenced by kyphotic measurements.

Mobilization was initiated on the second postoperative day. Return to work was restricted for both patients until the 6th month postoperatively.[12]

With no noted complications at their one year follow-up, both patients resumed their normal activities. Patient A resumed her part-time job as a baker while Patient B resumed work as a digital media manager.

CONCLUSION

We successfully treated two patients with osteogenesis imperfecta with associated scoliosis using non-fenestrated pedicle screws without cement augmentation. Instrumented levels were chosen based on the end vertebrae, the major and structural curves, and the presence of pelvic obliquity. However, our data cannot justify any conclusion regarding the use of fenestrated screws or cement augmentation. Loss of correction and screw pull-outs should subsequently be monitored. Further studies on different fixations need to be conducted for patients with osteogenesis imperfecta and scoliosis.

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ETHICAL CONSIDERATION

Patient consent forms were obtained before manuscript submission.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

CREDIT AUTHOR STATEMENT

BLAC: Methodology, Formal analysis, Investigation, Resources, Data Curation, Writing – original draft preparation, Writing – review and editing, Visualization; **AGH:** Investigation, Project administration; **SAG:** Conceptualization, Writing – review and editing, Supervision, **AKGA:** Validation, Writing – review and editing, Supervision

AUTHOR DISCLOSURE

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

No datasets were generated or analyzed for this research.

FUNDING SOURCE

None.

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CASE REPORT

Traumatic Amputation of the Thumb at the Proximal Phalanx: A Successful Reconstruction with Gillies' Technique and Reverse Radial Forearm Flap: A Case Report

Cristine G. Crisologo, MD,[1] Giselle T. Gabriel, MD, FPOA,[1,2] Raymar L. Sibonga, MD, FPOA[1,2]

[1]*Department of Orthopaedics, Makati Medical Center, Makati City, Philippines,*
[2]*Department of Orthopaedics, De La Salle University Medical Center, Dasmariñas City, Cavite, Philippines*

ABSTRACT

This case report describes a successful thumb reconstruction using a Gillies' lengthening procedure and a reverse radial forearm flap in a 31-year-old man who suffered a traumatic thumb amputation at the level of the proximal phalanx with approximately 0.5 cm of bony stump. An iliac crest bone graft lengthened the thumb, and the radial forearm flap provided sensate coverage. Postoperatively, the flap showed excellent viability, and the reconstructed thumb achieved near-contralateral length, improving hand function.

Keywords. amputation, thumb injuries, surgical flaps, bone transplantation, hand function restoration, Gillies' lengthening procedure

INTRODUCTION

Sensibility is vital to the thumb's role in pinch and grip, making it important to consider reconstructing an amputated thumb. Thumb reconstruction is a complex surgical procedure that aims to restore the thumb's function and appearance. The Gillies' operation, a pioneering technique developed in the mid-20th century, significantly advanced the field of thumb reconstruction.[1] Originally described by Sir Harold Gillies in 1946, the Gillies' operation involves lengthening a partially amputated thumb using a distally based flap and a bone graft. This innovative approach provided a solution for patients with thumb loss, particularly at the metacarpophalangeal joint level. A sensate flap, which provides skin coverage and sensation, is essential for successful hand reconstruction. The radial forearm flap is a versatile, reliable, and sensate option for covering skin defects, offering several advantages over other flap options.[2] This flap's ease of harvest and potential for simultaneous transfer with nerve, tendon, or bone allows for comprehensive reconstruction, addressing skin defects and sensory deficits in conjunction with osseous lengthening procedures like the Gillies' operation.

CASE

This is a case of a 31-year-old, left-handed man who suffered a traumatic amputation of his right thumb at the level of the proximal phalanx two months prior. He was initially brought to a nearby hospital, where debridement and closure were performed. The metacarpophalangeal (MCP) joint articular surface was intact. There remained 0.5 cm of the proximal

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Corresponding author: Cristine G. Crisologo, MD
Department of Orthopaedics, Makati Medical Center,
2 Amorsolo Street, Legazpi Village,
Makati, 1229 Philippines
E-mail: kaycrisologo@yahoo.com

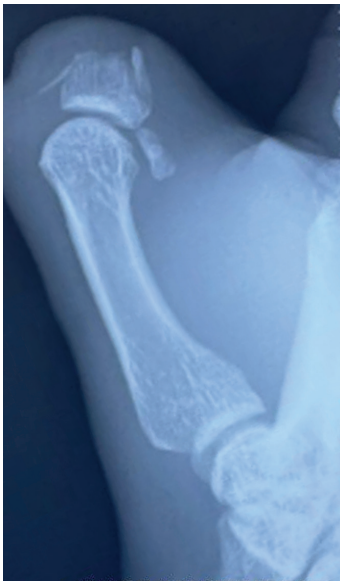

Figure 1. Injury film showing thumb X-ray: lateral view.

Figure 2. Repeat x-ray taken 20 days post-injury. Anterior-Posterior (AP) view of the affected thumb demonstrate persistent findings. (+) Bone lysis is noted, with smoother distal ends compared to initial imaging. No significant change in size is observed.

Figure 3. Preoperative clinical photographs [palmar **(A)** and radial **(B)** views] show no open wounds, signs of infection, erythema, or tenderness.

phalanx (Figure 1). Repeat radiographs after 20 days revealed bone lysis and smoother distal ends of the stump, which remained approximately the same size (Figure 2). Clinically, the stump was fully healed without open wounds or tenderness. The patient exhibited full range of motion of the MCP joint in flexion, extension, abduction, and adduction. Preoperatively, the patient's Fil-Dash Score was 90, and the Sollerman hand function test score on the right hand was 65, compared to 80 on the left (Figure 3).

We lengthened the thumb as follows. We harvested a 4 x 1.5 cm tricortical graft from the iliac crest and shaped it into a peg proximally with a curvilinear distal edge (Figure 4). The peg was inserted into the medullary canal of the first metacarpal after drilling with a 4 mm bit to achieve a press-fit construct (Figure 5). Due to scarring and limited mobility of the stump, a reverse radial forearm flap was also performed. The flap was harvested together with an intact subfascial layer. The superficial radial nerve was preserved and anastomosed to the lateral antebrachial cutaneous nerve to maintain flap sensation. The flap demonstrated excellent color, turgor, and capillary refill. The final thumb length of 7 cm was comparable to the contralateral thumb (Figure 6). The flap remained viable through regular monitoring (Figures 7 and 8) Radiographs taken every two weeks showed a stable peg, no loosening, and signs of fusion (Figures 9 and 10).

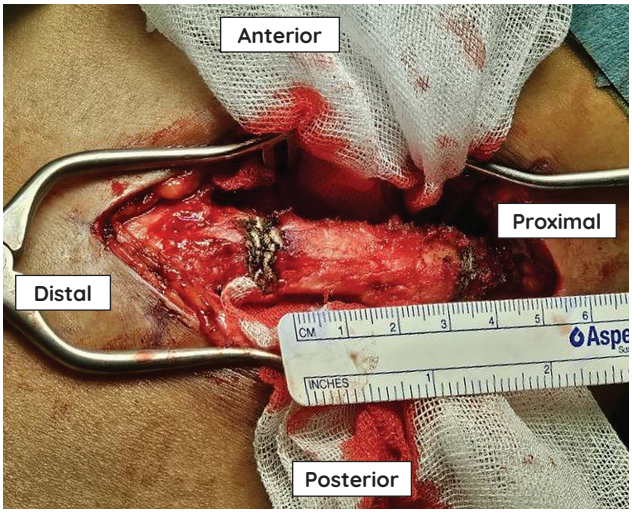

Figure 4. A 5 cm longitudinal incision was made along the long segment from the full thickness of the iliac crest. Tricortical graft measuring 4 x 1.5 cm was harvested.

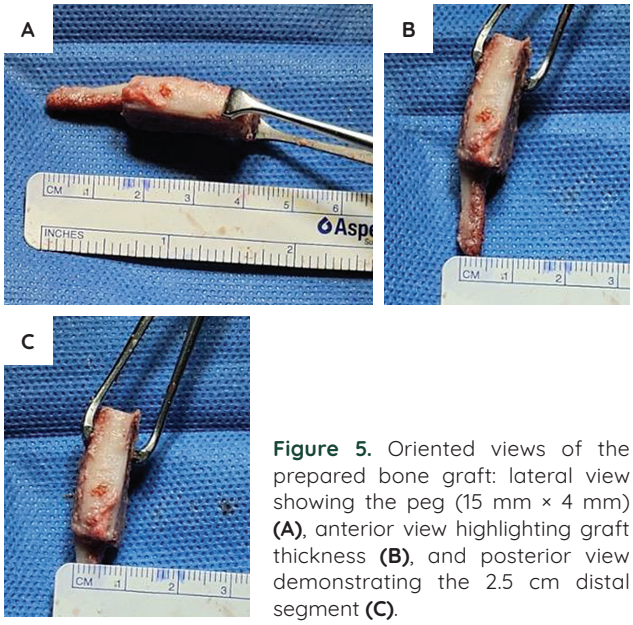

Figure 5. Oriented views of the prepared bone graft: lateral view showing the peg (15 mm × 4 mm) **(A)**, anterior view highlighting graft thickness **(B)**, and posterior view demonstrating the 2.5 cm distal segment **(C)**.

At six weeks postoperatively, the patient's Fil-Dash Score was 72, compared to 90 preoperatively, and the Sollerman hand function test score on the right hand was 77, compared to 65 preoperatively (Figure 11).

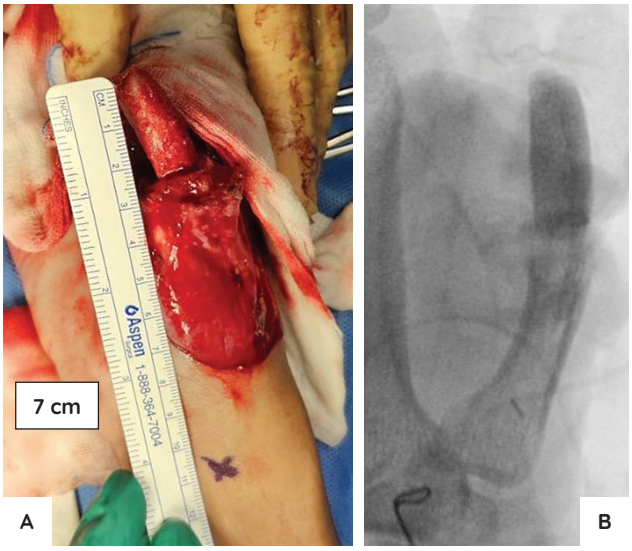

Figure 6. Intraoperative image showing the reconstructed right thumb with a total length of 7 cm achieved **(A)**. Lateral view **(B)** confirm alignment and graft positioning.

DISCUSSION

The Gillies' thumb lengthening procedure is regarded as one of the most effective methods for thumb reconstruction, particularly around the metacarpophalangeal joint, and can be performed as a single-stage operation. As described by Reid in 1980, this technique yields a functional grasp that is comparable to that of an intact index finger.[1] The Gillies' procedure serves as a standalone method for thumb lengthening and often incorporates bone grafting and skin coverage, making it the preferred technique in our case.

Intraoperative findings of significant scarring and restricted stump mobility necessitated the use of a sensate reverse radial forearm flap in combination with the Gillies' procedure.[3,4] Yajima et al. note that the disadvantages of the reverse radial forearm flap include the prolonged time required for reinnervation due to the length of the nerve pedicle, as well as the relatively diminished sensation when compared to the native digits.[2] Additionally, the procedure creates a secondary defect on the anterior forearm that necessitates coverage with a split-thickness skin graft, resulting in a permanent and visible cosmetic deformity.

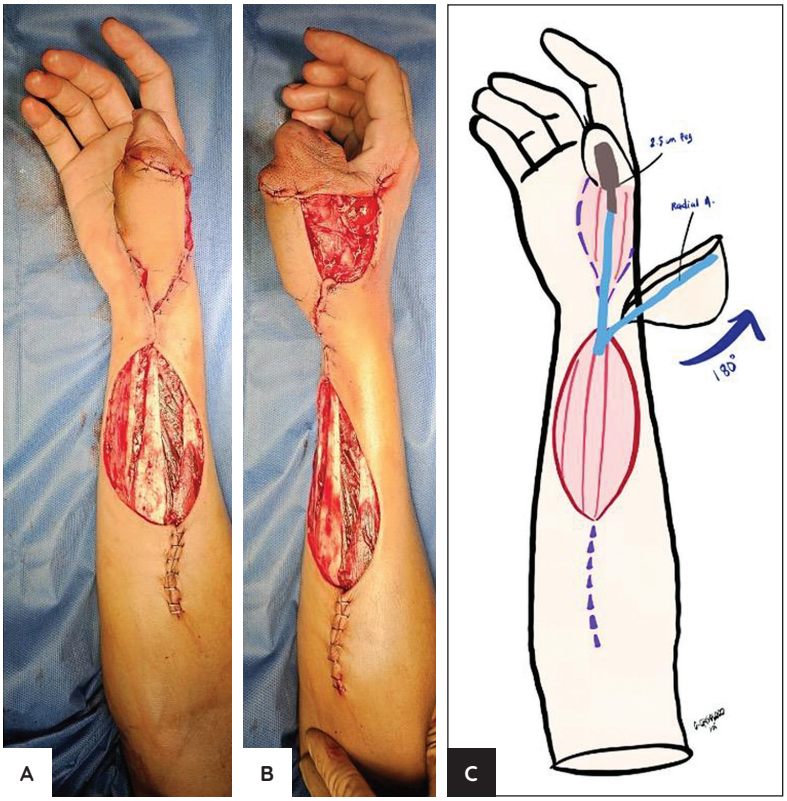

Figure 7. Radial forearm flap elevation and inset. Intraoperative view of the left forearm in supination, showing the elevated radial forearm flap with fascia and radial artery dissected from proximal to distal **(A)**, Pronated view of the same forearm showing flap mobility and vascular pedicle length **(B)**, Schematic illustration showing 180-degree rotation of the flap and its inset into the dorsoradial defect of the first metacarpal, secured to the native metacarpal stump **(C)**.

Figure 8. Split-thickness skin graft coverage. Volar view of the forearm and hand showing a split-thickness skin graft (STSG) placed over the anterior forearm donor site **(A)**. Dorsal view demonstrating the STSG inset over the dorsum of the reconstructed thumb. The graft was harvested from the contralateral thigh **(B)**.

Figure 9. Postoperative follow-up at 2 months. Dorsoradial view of the reconstructed thumb showing good graft take without signs of infection or necrosis **(A)**. Dorsal forearm view showing a well-healed skin graft over the flap donor site **(B)**. Volar view of the forearm and hand demonstrating intact skin grafts and healing along the radial forearm flap harvest and inset site **(C)**.

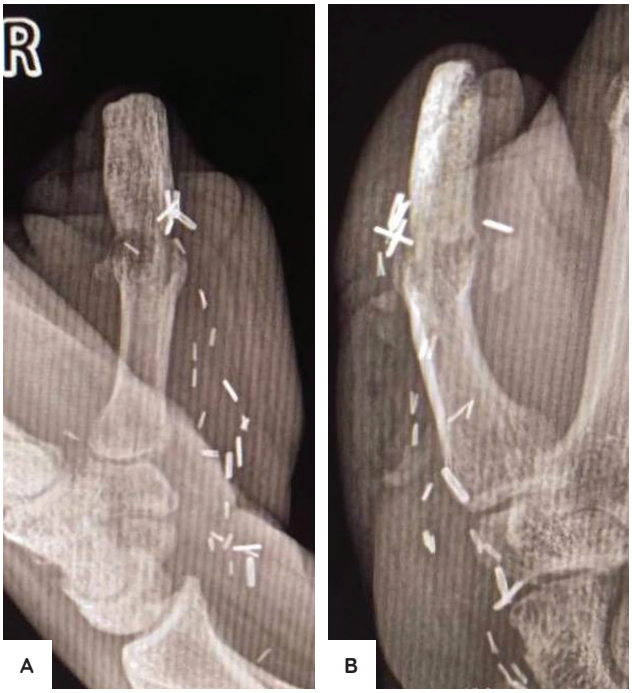

Figure 10. Radiographic evaluation at 2 months postoperatively. Lateral view **(A)** and anteroposterior (AP) view **(B)** of the right thumb demonstrate stable fixation and radiographic evidence of graft incorporation without signs of loosening, fracture, or infection.

CONCLUSION

This case demonstrates the successful reconstruction of a traumatically amputated thumb at the proximal phalanx level using a Gillies' lengthening procedure with iliac bone graft and a reverse radial forearm flap with nerve coaptation. This dual approach effectively achieved both adequate length and sensate soft tissue coverage, leading to improved hand function as evidenced by the postoperative Fil-Dash and Sollerman scores at six weeks. While acknowledging the limitations associated with the reverse radial forearm flap, such as the potential for prolonged reinnervation and donor site morbidity, the early functional outcomes in this case highlight the value of this combined technique in addressing complex thumb reconstruction challenges where both skeletal length and sensibility are critical for functional recovery. Further long-term follow-up will be essential to fully evaluate the sustained functional benefits and sensory recovery in this patient.

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Figure 11. Clinical follow-up at 4 months postoperatively. Volar view showing well-healed radial forearm flap donor site and integration of the flap into the reconstructed thumb **(A)**. Radial view of the hand demonstrating soft tissue bulk and flap contour over the neothumb **(B)**. Dorsal view highlighting stable skin graft incorporation without signs of infection, breakdown, or contracture **(C)**.

ETHICAL CONSIDERATION

Patient consent form was obtained before manuscript submission.

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AUTHOR DISCLOSURE

The authors declared no conflict of interest.

DATA AVAILABILITY STATEMENT

No datasets were generated or analyzed for this research.

FUNDING SOURCE

None.

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