Vazales R, et al., Archiv Surg S Educ 2024, 6: 053
DOI: 10.24966/ASSE-3126/100053

HSOA Archives of Surgery and Surgical Education

Research Article

Preventogen: Shifting The Clinical Paradigm of Pin Site Care and Transosseous Wire Infections Associated with External Fixation in Limb Trauma & Reconstruction

Ryan Vazales[1], Antonio Delgado-Perez[2], Alfonso Migoya-Nuño[3] and Edgardo Rodriguez-Collazo[4]* Aaron Pacheco-Guemez[5]

[1]Dept of Surgery; St Mary's Hospital, Richmond Virginia. Adult and Pediatric Lower Limb Deformity Correction, Orthoplastic Surgery, USA

[2]Dept of Orthopaedics; Hospital Ortopedia Cruz Roja, Merida Mexico, Pediatric Orthopaedic & Traumatology, Limb Lengthening Orthoplastic & Microsurgery, USA

[3]Dept of Orthopaedics; Centro Medico ABC Santa Fe, Mexico City. Pediatric Orthopaedic & Traumatology, Limb Lengthening Orthoplastic & Microsurgery, USA

[4]Dept of Surgery; Ascension Health Saint Joseph Hospital,Chicago IL. Adult and Pediatric Lower Limb Deformity Correction, Orthoplastic Surgery, USA

[5]Dept of Orthopaedics; Hospital Dr.Agustin O'Horan, Merida Mexico. Pediatric Orthopaedic & Traumatology, Limb Lengthening, Orthoplastic,USA

Abstract

External fixation is a versatile and indicated procedure for open/closed fractures, soft tissue and bone defects, significant infection including osteomyelitis, and limb deformity correction. Pin site infections associated with external fixation are a challenging problem caused by bacterial adhesion with biofilm formation. The current paradigm in treatment has been focused on patient selection, pin materials, operative technique, and oral antibiotic regimen and has been known to provide limited success often requiring complete removal of the pin.This larger case series and review aims to offer a paradigm shift and recommendation for future strategies for reducing pin site infections with utilization of external fixation, regardless of the type of pathology present.

Keywords: Limb deformity correction; Osteomyelitis; Minimally invasive surgery; Open surgery

***Corresponding author:** Edgardo Rodriguez-Collazo, Dept of Surgery; Ascension Health Saint Joseph Hospital,Chicago IL, USA. Adult and Pediatric Lower Limb Deformity Correction, Orthoplastic Surgery. E-mail: egodpm@gmail.com

Citation: Vazales R, Delgado-Perez A, Migoya-Nuño A, Rodriguez-Collazo E, Pacheco-Guemez A (2024) *Preventogen*: Shifting The Clinical Paradigm of Pin Site Care and Transosseous Wire Infections Associated with External Fixation in Limb Trauma & Reconstruction. Archiv Surg S Educ 6: 053.

Received: April 12, 2024; **Accepted:** April 18, 2024; **Published:** April 25, 2024

Introduction

Utilization of external fixation in orthopedic and ortho-plastic surgery is often the treatment of choice in the face of elective and non-elective complicated and challenging pathology. External fixation versatility and ability to be used in multiple different pathologic situations stems from its ability to create both static and dynamic stability both at and away from the pathology site, while at the same time, offering acute and/or gradual correction of the deformity. The rapid construction of an external frame secured through the bone with pins or half pins away from the zone of injury allows minimal soft tissue dissection/damage and can be combined with definitive internal fixation acutely or at a later date when elective or semi-elective procedures are indicated [1]. External fixation has a wide array of uses including trauma and severe injury, infection cases often combining osseous procedures with large soft tissue defects requiring flap utilization, as well as bone shortening/lengthening and deformity correction procedures.

Often, in both acute traumatic cases or semi-elective or elective procedures, these external fixators remain in place for many weeks or months to allow for a delay period, followed by acute or gradual correction, followed by complete consolidation or healing of the osseous or soft tissue deformity. One of the biggest concerns and potential complications for the surgeon utilizing external fixation is pin site infections caused by increasing mechanical deterioration of the pin to bone or pin to skin interface [1,2]. Operative technique, host selection, pin site loosening, pin material/coating, diagnosis of pin site infection and extensive list of pathologies amenable to treatment with external fixation, are all factors associated with the wide range of pin site infection rates reported in the literature ranging from as low as 3% to as high as 80% [3-4]. Even the most commonly used pin site infection classification by Checketts and Otterburn lacks consensus among the surgical community leaving interpretation of the data variable [7,8].

External fixator pin site infections are caused by the formation of bacterial adhesion around the pin in combination with creation of biofilm at the pin-soft tissue and pin-bone interface. This biofilm is formed by a collection of bacteria that attaches itself to a foreign material and is surrounded by an extracellular matrix. Bacterial cellular proliferation forms clusters in the extracellular matrix releasing a protective exopolysaccharide layer giving protection against host defense systems by decreasing the release of host chemotactic signals preventing migration of polymorphonuclear cells into the biofilm there by reducing degradation [9-13].

Many different techniques have been discussed in the literature to attempt to lower pin site infections. Low energy application of the pins minimizing thermal necrosis and damage to the soft tissues remains paramount to decrease pin site complications. Optimal regimen and

time course are yet to be determined for prophylactic antibiotics which are often utilized with pin site infections [14]. Post operative pin site care has also been extensively studied, however, currently, there remains no clear consensus or guideline regarding best practice in pin care to reduce the incidence of pin site infections. The optimal method to prevent and treat pin site and half pin tract infections remains controversial [15]. There is no strong evidence to support a specific choice of dressing type, cleansing material or frequency of cleansing regimen [14]. Furthermore, there is no universally accepted definition of pin site infection making it difficult to quantify the current data [15].

In this case series of 58 patients, we offer a step-wise, repeatable, effective approach as a part of pin site care postoperatively after external fixation application utilizing preventogen, a biologic polymer aimed at significantly lowering the risk of pin site infections regardless of the type of pathology present.

Preventogen: The Product

Preventogen is an FDA cleared Class1 medical device. This organic polymer, when applied to the disrupted skin in liquid form, eradicates all organisms on contact, regardless of antibiotic sensitivity. It then quickly transforms into an elastomeric, transparent, biodegradable and occlusive dressing. Preventogen actively kills Fungi, bacteria and virus on contact by lysing the cell membrane leading to quick death. A list of the bacteria, fungi and is seen in Table 1 and Figure 1 below.

BACTERIA	FUNGI	VIRUS
Escherichia Coli	Aspergillus Niger (superbug)	Herpes Simplex (cold sore)
Pseudomonas Aeruginosa	T. Rubrum	Herpes Zoster (shingles)
Staphylococcus Aureus	Candida Albicans	
MRSA (superbug)	D Aspergillus Brasiliensis	
VRE (superbug)	Candida auris (superbug)	
Acinetobacter Baumannii(-superbug)		
Bacillus Subtilis		
Clostridium Sporogenes		
Streptococcus Pyogenes		

Table 1: List of Bacteria, Fungi, Viruses Susceptible to Preventogen Polymer.

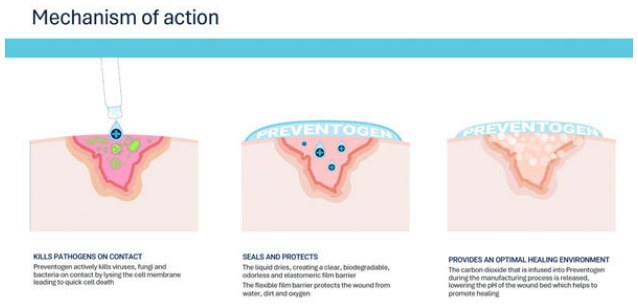

Figure 1: Preventogen mechanism of action.

Surgical Guidelines and Application Protocol

Application protocol is critical and should be performed by the orthopedic or orthoplastic surgeon. The product (Figure 2) is Ideal for infection prevention from "outside-in," not starting with an infected case. Preventogen must be applied to a clean, dry surface. It is important to let the patient know it may sting upon application. Preventogen creates a barrier, not a seal like surgical glue and is a biodegradable, organic polymer and will break down naturally if exudate forms below the preventogen-skin interface. Preventogen does not replace the absolute necessity for stable wire insertion and fixation. secure application of the external fixator following sound biomechanical Ilizarov principles including placement of pins in the diaphysis of long bones and at an ideal 60 degree angle from one another in a manner that minimizes thermal necrosis with simultaneous tensioning [16].

Our guidelines for pin site management were based on the algorithm devised by Checketts and Otterburn [7] with a primary focus on the addition of utilizing Preventogen polymer postoperatively (Table 2).

Grade 1	Pin Tract Irritation	If wire is loose, re-tension Soft tissue involvement receives local treatment and/or soft tissue release
Grade 2	Pin tract irritation with drainage	Grade 1 interventions Oral antibiotics
Grade 3	Erythema >2 cm radius from pin w/ drainage and low grade constitutional symptoms	Grade 1 interventions IV antibiotics
Grade 4	Erythema >2 cm radius, w/ drainage and radiographic evidence of localized osteolysis	Pin removal
Grade 5	Radiographic osteolysis with soft tissue infection	Pin removal with surgical debridement
Grade 6	Suspected osteomyelitis	Radiologic and imaging confirmation with possible bone resection

Table 2: Checketts et al. 2000, pin site infection classification.

Following deformity correction with provisional external fixation surgery.

Step 1: Apply Preventogen polymer to a clean dry transosseous wire or half pin-skin interface extending one inch around the pin site approximately one week post operative (not at the time of surgery to allow decreased swelling and drainage).

Step 2: continue to apply once per week until external fixation device is scheduled for removal as part of a comprehensive pin care protocol.

*generally requires 1 tube per leg per external fixator per week.

Results

Data of 58 patients who underwent external fixation surgery to manage a wide range of different pathologies (Table 3), amputation, arthrodesis, arthrodiastasis, fasciocutaneous flap, muscular flap, angular deformity correction, osseous distraction, bone stabilization, pelvic support osteotomy, non vascularized fibular graft, free fibula vascularized graft, tumor resection, bone transport) including open long bone fractures, bone deficits, soft tissue and bone infections, was collected from 3 different hospitals and reviewed retrospectively. All patients underwent surgical debridement, soft tissue reconstruction, bone reconstruction techniques and external fixation. as shown in (Table 4) & (Figure 3).

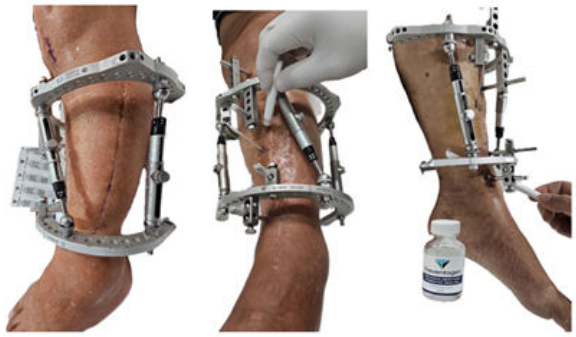

Figure 2: Product Application.

Figure 3: Product application.

Preventogen application was applied approximately 1 week from initial surgery and then on a weekly basis postoperatively as part of a comprehensive external fixator pin care protocol until the frame was removed, primary physician or trained orthopedic residents were in charge of applying Preventogen.

A total of patients N=29 different procedures in a variety of patients with different host type were performed by 3 different senior surgeons, (Table 5). All patients were treated with an external fixator, N=43 with a circular frame and N=15 with a uniplanar frame, a total of 329 pin wires and 139 schanz pins were used. A total of N=2 patients had pin tract infections, one patient with one pin insertion site and another patient with two pin insertion sites. Loosening of the pins was noted as a complication in two uniplanar frames, both of which

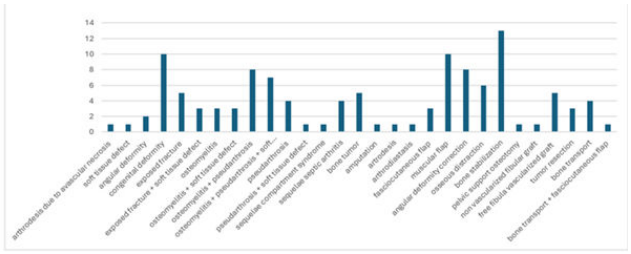

Table 3: Procedures.

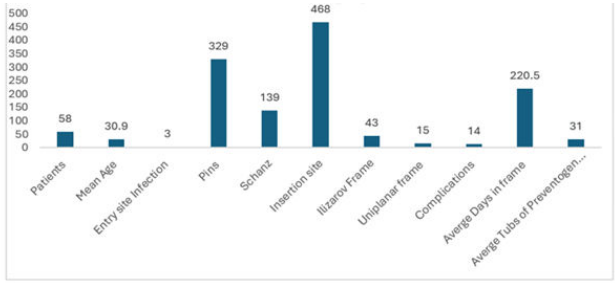

Table 4: Demographies.

required reapplication, but only one patient lost alignment. The overall pin site infection rate was 0.9 in 468 insertion sites, 14 patients presented with other complications apart from pin site infection as listed in (Table 6).

The goal of the research was to improve the overall protocol of postoperative pin site care leading to infection prevention in external fixation devices. The prevetogen polymer, when utilized as part of the pin-care protocol, prevented infection at the source of the pin site-skin interface which is a notable shift in clinical practice paradigms.

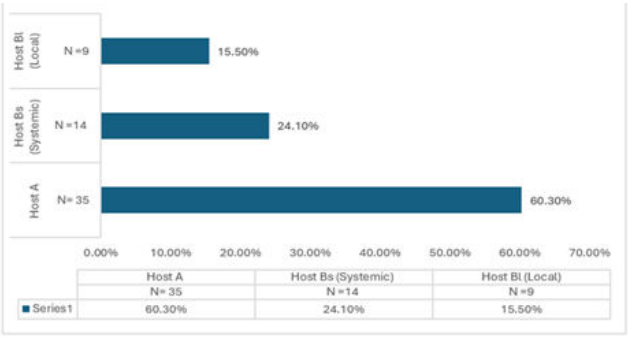

Table 5: Host Type.

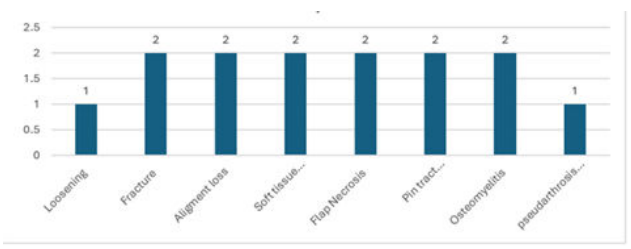

Table 6: Complications.

External fixation is routinely utilized in multiple different types of pathology including long bone and open fractures, soft tissue defects, and bone infections such as osteomyelitis, bone lengthening/shortening procedures and deformity correction. It has several benefits allowing orthoplastic surgeons the ability to address soft tissue and osseous defects simultaneously creating stability both at the pathology site and away from an infected area [17]. Despite its widespread use and benefits, there continue to be long-standing challenges and complications associated with external fixation.

Fracture-Related Infection (FRI), and Surgical Site Infections (SSIs) are serious and challenging complications in musculoskeletal trauma. Current studies have shown FRI rates to be as high as 27% with open fractures [18,19]. Musculoskeletal injury poses a significant global health challenge, particularly in low-and middle-income countries (LMICS), resulting in nearly 90% of trauma-related deaths worldwide [20]. Open tibial fractures are one of the most frequently reported traumatic injuries, and are associated with high rates of infection, nonunion and malunion. Furthermore, road traffic accidents have contributed to the rise in the incidence of open Tibia fractures, which has led to over 50,000 open fractures per year in some Latin American Countries. Complication rates in this very challenging pathology group have been documented reaching as high as 20% [20].

External fixation is often indicated and utilized in open and closed fractures, bone and soft tissue defects, and severe infection, and these very challenging pathologies occur in multiple different patient populations. It has been documented that older patients with multiple comorbidities, prolonged treatment duration and those undergoing active correction with ex fix are at increased risk of complications [21] These patient populations often require high acuity acute care and long-standing hospitalization driving up the cost of healthcare. FRI cases generate as much as 6.5 times higher healthcare costs than non-infected cases, due to increased hospital stay. recurrence rates have been documented to be as high as 9% and reported successful treatment rates at 70%. Often, these cases require multiple surgeries and despite the surgeons' best efforts, amputation rates of 3% have also been documented in the literature [22]. Furthermore, Studies have estimated the average cost of a SSI to be more than $25,000, increasing to more than $90,000 if the SSI involves a prosthetic implant [23]. A growing concern globally is the potential associated rise in healthcare cost associated with SSIs and FRIs as surgical procedures for patient populations with increasingly more complex comorbidities combined with challenging pathology continue to increase.

The most common reported complication associated with external fixation is pin site infection [1,4]. This complication can result in delayed healing, permanent functional loss and even limb loss/amputation leaving a long-lasting and be life altering impact on a patient's quality of life. Previous studies have shown Preventogen's effectiveness in dramatically reducing the rate of pin site infections related to external fixation [24,25]. Since reimbursement/cost is a limiting factor for both external and internal fixation, and external fixation is uniquely identified as a versatile and indicated procedure with these highly challenging patient populations, there is a goal to make a positive impact on the external fixation market through the reduction of the incidence of pin site infection associated with its use.

In our study of N=58 patients, we found that with the use of preventogen, there were no readmission rates, no major complications and the authors did not have to change treatment plan or remove wires or the external fixators earlier than planned throughout the course of treatment, despite the need for longer times in the external fixator due to the challenging pathology encountered. Furthermore, there was no radiographic or clinical evidence of osteomyelitis or infections of the pin sites of the external fixators.

Limitations of the study include a no incidence of type C [26] patients which have chronic metabolic diseases such as Diabetes in the patient population which may not be a good representation of the overall patient population that often undergoes utilization of external fixation particularly in other countries. The findings of this study noting very low incidence of pin site infections in both a large cohort of host Type A and a lesser cohort of host Type B patients is encouraging. It currently remains unclear as to whether or not diabetes and other chronic metabolic diseases will affect the success of Preventogen or other biologic polymers as part of the protocol for post operative external fixation pin site management or increase the likelihood for post operative pin site infections. Further research is needed to investigate the effect of chronic metabolic diseases as they relate to pin site management in a multitude of different types of pathology that lend to external fixation utilization.

Conclusion

Pin site infections associated with external fixation continue to be a challenging problem. Currently there are limited treatment options available and when these fail the results can be disastrous for the patient, often leading to increased risk for readmission and raising the cost of care. As per the latest literature, it is evident that modulating the pin–bone or pin–skin interface holds promise as a potential solution for reducing pin tract infections. Transitioning to utilizing a novel biodegradable and microbicidal polymer specifically at the pin-skin interface is a shift in the clinical paradigm.

Preventogen does not replace the absolute necessity for stable wire insertion and fixation. secure application of the external fixator following sound biomechanical Ilizarov principles including placement of pins in the diaphysis of long bones and at an ideal 60 degree angle from one another in a manner that minimizes thermal necrosis with simultaneous tensioning Preventogen is applied early, within the first week of pin application where there is the highest risk for bacterial adhesion and formation of biofilm due to weakened host defense mechanisms. The product is easy to use and provides a repeatable result with a multitude of different skill sets for those applying it. It is tolerated well by patients. Preventogen has demonstrated its effectiveness as a bioorganic polymer occlusive dressing, that when utilized as part of the pin site care protocol with external fixation, can reduce the incidence of pin site infections.

References

1. Moroni A, Vannini F, Mosca M, Giannini S (2002) State of the art review: techniques to avoid pin loosening and infection in external fixation. J Orthop Trauma 16:189-195.

2. Saithna A (2010) The influence of hydroxyapatite coating of external fixator pins on pin loosening and pin track infection: A systematic review. Injury 41: 128-132.

3. Collinge CA, Goll G, Seligson D, Easley KJ (1994) Pin tract infections: Silver vs uncoated pins. Orthopedics 7: 445-448.

4. Parameswaran AD, Roberts CS, Seligson D, Voor M (2003) Pin tract infection with contemporary external fixation: how much of a problem? J Orthop Trauma17: 503-507.

5. Patterson M (2005) Multicenter pin care study. Orthop Nurs 24: 349-360.

6. Clint SA, Eastwood DM, Chasseaud M, Calder PR, Marsh DR (2010) The "Good, Bad and Ugly" pin site grading system: A reliable and memorable method for documenting and monitoring ring fixator pin sites. Injury 41: 147-150.

7. Checketts RG, Otterburn M (1993) Pin tract infection: Definition, incidence and prevention. Int J Orthop Trauma 3: 6-8.

8. Santy-Tomlinson J, Vincent M, Glossop N, Jomeen J, Pearcey P (2011) Calm, irritated or infected? The experience of the inflammatory states and symptoms of pin site infection and irritation during external fixation: A grounded theory study. J Clin Nurs 20: 163-173.

9. Kiedrowski MR, Horswill AR (2011) New approaches for treating staphylococcal biofilm infections. Ann N Y Acad Sci 1241: 104-121.

10. Holt J, Hertzberg B, Weinhold P, Storm W, Schoenfisch M, et al. (2011) Decreasing bacterial colonization of external fixation pins through nitric oxide release coatings. J Orthop Trauma 25: 432-437.

11. Abee T, Kovács AT, Kuipers OP, van der Veen S (2011) Biofilm formation and dispersal in Gram-positive bacteria. Curr Opin Biotechnol 22: 172-179.

12. Arciola CR, Campoccia D, Speziale P, Montanaro L, Costerton JW (2012) Biofilm formation in Staphylococcus implant infections. A review of molecular mechanisms and implications for biofilm-resistant materials. Biomaterials 33: 5968-5982.

13. Costerton JW, Montanaro L, Arciola CR (2005) Biofilm in implant infections: its production and regulation. Int J Artif Organs 28: 1062-1068.

14. Kazmers NH, Fragomen AT, Rozbruch SR (2016) Prevention of pin site infection in external fixation: A review of the literature. Strategies Trauma Limb Reconstr 11:75-85.

15. Lethaby (2008) Cochrane Database Sys Rev.

16. Schnack LL, Oexeman S, Rodriguez-Collazo ER (2022) An Update on the Practical Management of a Hexapod System in Lower Limb Orthoplastic Reconstruction for Acute Shortening and Relengthening Procedures. Eplasty 22: e6.

17. Rodriguez-Collazo E (2019) Practical Management of the Orthofix Truelok External Circular Fixator in Deformity Correction and Lower Limb Salvage. International Journal of Orthoplastic Surgery 2: 55-61.

18. Madeline CM, Flores JM, Giordano V, Terry MJ, Garuz M, et al. (2022) Management of soft-tissue coverage of open tibia fractures in Latin America: Techniques, timing, and resources. Injury 53: 1422-1429.

19. Lu V, Zhang J, Patel R, Zhou AK, Thahir A, et al. (2022) Fracture Related Infections and Their Risk Factors for Treatment Failure-A Major Trauma Centre Perspective. Diagnostics (Basel) 12: 1289.

20. Cordero DM, Miclau TA, Paul AV, Morshed S, Miclau T, et al. (2020) The global burden of musculoskeletal injury in low and lower-middle income countries: A systematic literature review. OTA Int 3: e062.

21. Egol (2006) J Bone Joint Surg Am 88: 349-354.

22. O'Connor O, Thahir A, Krkovic M (2022) How Much Does an Infected Fracture Cost? Arch Bone Jt Surg 10: 135-140.

23. Perma, Shital (2018) Retrospective Evaluation of Microbicidal Polymer Dressing for Reduction of Infection Following Post Deformity Correction Surgery". Journal of Drugs in Dermatology 17: 723-725.

24. Checketts RG, MacEachem AG, Otterbum M (2000) Pin track infection and the principles of pin site care. In: De Bastiani G, Aplay AG, Goldberg A eds. *Orthofix External Fixation in Trauma and Orthopaedics*. Springer 2000: 97-103.

25. Calhoun JH, Cierny G 3rd, Holtom P, Mader J, Nelson CL (1994) Symposium: Current concepts in the management of osteomyelitis. Contemp Orthop 28: 157-185.

26. Conway JD, Hambardzumyan V, Patel NG, Giacobbe SD, Gesheff MG (2021) Immunological evaluation of patients with orthopedic infections: taking the Cierny-Mader classification to the next level. J Bone Jt Infect 6: 433-444.

HERALD

Advances In Industrial Biotechnology | ISSN: 2639-5665

Advances In Microbiology Research | ISSN: 2689-694X

Archives Of Surgery And Surgical Education | ISSN: 2689-3126

Archives Of Urology

Archives Of Zoological Studies | ISSN: 2640-7779

Current Trends Medical And Biological Engineering

International Journal Of Case Reports And Therapeutic Studies | ISSN: 2689-310X

Journal Of Addiction & Addictive Disorders | ISSN: 2578-7276

Journal Of Agronomy & Agricultural Science | ISSN: 2689-8292

Journal Of AIDS Clinical Research & STDs | ISSN: 2572-7370

Journal Of Alcoholism Drug Abuse & Substance Dependence | ISSN: 2572-9594

Journal Of Allergy Disorders & Therapy | ISSN: 2470-749X

Journal Of Alternative Complementary & Integrative Medicine | ISSN: 2470-7562

Journal Of Alzheimers & Neurodegenerative Diseases | ISSN: 2572-9608

Journal Of Anesthesia & Clinical Care | ISSN: 2378-8879

Journal Of Angiology & Vascular Surgery | ISSN: 2572-7397

Journal Of Animal Research & Veterinary Science | ISSN: 2639-3751

Journal Of Aquaculture & Fisheries | ISSN: 2576-5523

Journal Of Atmospheric & Earth Sciences | ISSN: 2689-8780

Journal Of Biotech Research & Biochemistry

Journal Of Brain & Neuroscience Research

Journal Of Cancer Biology & Treatment | ISSN: 2470-7546

Journal Of Cardiology Study & Research | ISSN: 2640-768X

Journal Of Cell Biology & Cell Metabolism | ISSN: 2381-1943

Journal Of Clinical Dermatology & Therapy | ISSN: 2378-8771

Journal Of Clinical Immunology & Immunotherapy | ISSN: 2378-8844

Journal Of Clinical Studies & Medical Case Reports | ISSN: 2378-8801

Journal Of Community Medicine & Public Health Care | ISSN: 2381-1978

Journal Of Cytology & Tissue Biology | ISSN: 2378-9107

Journal Of Dairy Research & Technology | ISSN: 2688-9315

Journal Of Dentistry Oral Health & Cosmesis | ISSN: 2473-6783

Journal Of Diabetes & Metabolic Disorders | ISSN: 2381-201X

Journal Of Emergency Medicine Trauma & Surgical Care | ISSN: 2378-8798

Journal Of Environmental Science Current Research | ISSN: 2643-5020

Journal Of Food Science & Nutrition | ISSN: 2470-1076

Journal Of Forensic Legal & Investigative Sciences | ISSN: 2473-733X

Journal Of Gastroenterology & Hepatology Research | ISSN: 2574-2566

Journal Of Genetics & Genomic Sciences | ISSN: 2574-2485

Journal Of Gerontology & Geriatric Medicine | ISSN: 2381-8662

Journal Of Hematology Blood Transfusion & Disorders | ISSN: 2572-2999

Journal Of Hospice & Palliative Medical Care

Journal Of Human Endocrinology | ISSN: 2572-9640

Journal Of Infectious & Non Infectious Diseases | ISSN: 2381-8654

Journal Of Internal Medicine & Primary Healthcare | ISSN: 2574-2493

Journal Of Light & Laser Current Trends

Journal Of Medicine Study & Research | ISSN: 2639-5657

Journal Of Modern Chemical Sciences

Journal Of Nanotechnology Nanomedicine & Nanobiotechnology | ISSN: 2381-2044

Journal Of Neonatology & Clinical Pediatrics | ISSN: 2378-878X

Journal Of Nephrology & Renal Therapy | ISSN: 2473-7313

Journal Of Non Invasive Vascular Investigation | ISSN: 2572-7400

Journal Of Nuclear Medicine Radiology & Radiation Therapy | ISSN: 2572-7419

Journal Of Obesity & Weight Loss | ISSN: 2473-7372

Journal Of Ophthalmology & Clinical Research | ISSN: 2378-8887

Journal Of Orthopedic Research & Physiotherapy | ISSN: 2381-2052

Journal Of Otolaryngology Head & Neck Surgery | ISSN: 2573-010X

Journal Of Pathology Clinical & Medical Research

Journal Of Pharmacology Pharmaceutics & Pharmacovigilance | ISSN: 2639-5649

Journal Of Physical Medicine Rehabilitation & Disabilities | ISSN: 2381-8670

Journal Of Plant Science Current Research | ISSN: 2639-3743

Journal Of Practical & Professional Nursing | ISSN: 2639-5681

Journal Of Protein Research & Bioinformatics

Journal Of Psychiatry Depression & Anxiety | ISSN: 2573-0150

Journal Of Pulmonary Medicine & Respiratory Research | ISSN: 2573-0177

Journal Of Reproductive Medicine Gynaecology & Obstetrics | ISSN: 2574-2574

Journal Of Stem Cells Research Development & Therapy | ISSN: 2381-2060

Journal Of Surgery Current Trends & Innovations | ISSN: 2578-7284

Journal Of Toxicology Current Research | ISSN: 2639-3735

Journal Of Translational Science And Research

Journal Of Vaccines Research & Vaccination | ISSN: 2573-0193

Journal Of Virology & Antivirals

Sports Medicine And Injury Care Journal | ISSN: 2689-8829

Trends In Anatomy & Physiology | ISSN: 2640-7752