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Case Report

SKINTED: an uncommon cutaneous complication of total knee replacement

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Abstract: Surgery of the *k*nee, injury to the *i*nfrapatellar branch of the saphenous *n*erve, *t*raumatic *e*czematous *d*ermatitis (SKINTED) involving the skin lateral to the surgical incision/scar area is a site- and procedure-specific diagnosis associated with total knee replacement surgery. It results from autonomic denervation following surgical trauma to the nerve and occurs months to years after surgical trauma. It needs to be differentiated from post traumatic eczema/dermatitis, neuropathic dermatitis and contact dermatitis/sensitization due to topical therapies or implant material. Herein, we report a case of 70-year-old woman having no preexisting medical or dermatological disorder of significance presenting with eczematous lesions around both knees lateral to the incision site developing few months after bilateral total knee replacement surgery. Treatment with twice daily application of betamethasone dipropionate 0.05% cream, gabapentine 100 mg/d PO and liberal use of bland emollient cream given over 2 months was remittive without recurrence during more than one year of follow up. Since its exact prevalence, pathophysiology and clinical course remain uncertain its awareness remains relevant to both dermatologists and orthopedic surgeons to address unnecessary anxiety and dissatisfaction of the patient.

Keywords: Autosomal denervation dermatitis, hypoesthesia, immunocompromised districts, infra patellar branch of saphenous nerve, neuropathy, post-traumatic eczema, trophoneurosis

Introduction

The saphenous nerve, a division of the femoral nerve, descends distally and medially to the patellar tendon giving off infrapatellar branch that crosses from medial to lateral side below the patella (**Figure 1**). However, this infrapatellar branch of saphenous nerve (IPbSN) is reported to have many anatomical variations in its course and branching patterns [1, 2]. It is purely a sensory nerve and supplies the skin over front and inferolateral aspect of the knee [3]. It gets frequently injured during a number of knee surgeries including total knee replacement (TKR) due to its subcutaneous course with an estimated prevalence of 22% to 70% of all iatrogenic injuries [3, 4]. This leads to sensory disturbances in the innervated skin lateral to the incision and rarely skin eruptions develop within the hypoesthetic area 3 to 6 months after the surgery [4]. This has been often labeled as autonomic denervation dermatitis (ADD), neuropathy dermatitis, or post traumatic eczema in the literature [5-10]. Its exact prevalence is unknown and there are only 82 cases documented mostly as case reports or small case series [11]. Recently the nomenclature, SKINTED, an acronym for Surgery of the *k*nee, injury to the *i*nfrapatellar branch of the saphenous *n*erve, *t*raumatic *e*czematous *d*ermatitis, has been suggested for all such cases associated with TKR [7]. However, data for exact prevalence of SKINTED is lacking and only one study by Nazeer et al [4] has reported its prevalence of 4.4% of 203 TKR surgeries performed by them in one year. Apparently, this unusual entity remains under diagnosed/reported due to lack of awareness or perhaps because of confusion with other more common dermatoses related to dryness or allergic reactions after the surgical procedure.

Typically, the dry, scaly, erythematous eruption of pruritic macules or rarely papulovesicles and

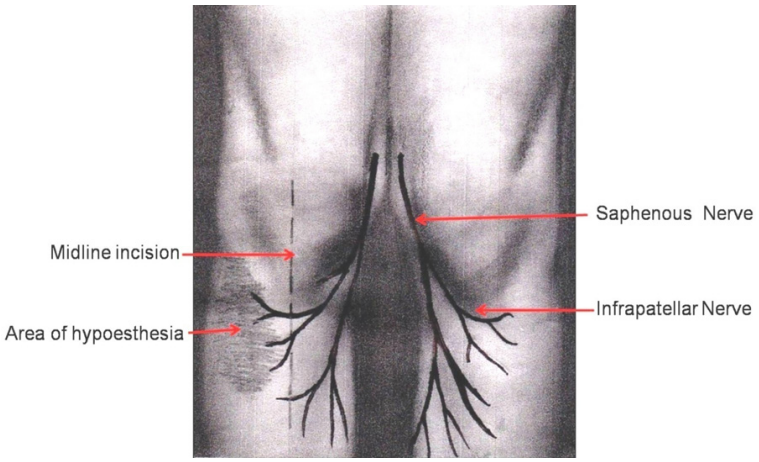

Figure 1. Graphic illustration of approximate anatomical location of saphenous nerve descending along the medial side of the knee, its infrapatellar branches crossing the midline between patella and tibial tubercle supplying the anterior knee and surrounding area. Shaded area depicts area of hypoesthesia after total knee replacement surgery.

crusting localized lateral to the incision site starts at about 3 to 6 months after the TKR invariably with healing of the incision [4]. Most patients experience anesthesia/hypoesthesia in the area soon after the surgery that resolves along with evolving of the eruption [7]. It may simulate allergic dermatitis occurring around the TKR incisions from adhesive tapes, pre- and post-operative topical antimicrobial preparations used as scrubs/dressings or rarely due to hypersensitivity to metal implants [12]. The histological features of skin lesions are not pathognomic and its diagnosis is mainly clinical based on characteristic presentation, good therapeutic outcome and self limiting clinical course. An adequate pre-operative counseling of patient for the possibility of its occurrence, early recognition and accurate management remain imperative. However, these lesions often remain unrecognized as they usually occur more than 2 weeks after the surgery or may get secondarily infected making early recognition and differentiation difficult from other dermal complications. Herein, we report a case of SKINTED and review relevant literature to understand clinical and pathophysiology attributes with an idea to make orthopedic surgeons and dermatologists aware of this uncommon post operative complication of TKR surgery.

Case report

A 70-year-old woman presented with mildly itchy, erythematous, dry, scaly dermatitic lesions over the lateral aspect of both knees developed 3 months after bilateral TKR surgery. Historically, she had bilateral knee pain for over 8 years that was diagnosed as primary osteoarthritis of the knees. As she did not respond to medical management, simultaneous bilateral TKR was performed with standard midline incisions. The implant used had femoral component made of cobalt chromium, tibial component of titanium and the insert was of ultrahigh-molecular-weight polyethylene. Skin staples were used for wound closure and dressed with occlusive polyurethane film (3M Tegaderm™). There were no intraoperative complications or allergic skin reaction to the dressing materials and the postoperative period was uneventful. She developed hypoesthesia lateral to the well healed incision corresponding to the innervation of the infrapatellar branch of the saphenous nerve and progressively increasing skin lesions at the infero-lateral aspect of the knee overlying the hypoesthetic region three months after the surgery. She denied any history of topical application. Clinically, the lesions were bilateral and asymmetric in distribution, never crossed the skin incision, mildly pruritic, erythematous plaques studded with papules and few vesicles suggestive of subacute dermatitis. The lesions over the left knee were larger than those over right knee. They showed well-defined irregular borders and measured about 9×7 cm over the left knee and 3×2 cm over the right knee (**Figure 2**). The lesions were non-tender and local temperature was not raised. Sensory examination showed decreased sensations for light touch and pinprick lateral to the incision scar corresponding to the dermatitis lesions. Other cutaneous and systemic examination showed no abnormity. No fungal element was visualized in KOH mounts. Complete blood counts and serum biochemistry were normal and patch testing with Indian standard series showed no sensitivity to cobalt or chromium [13]. She did not volunteer for skin biopsy. Treatment with twice daily topical application of betamethasone dipropionate 0.05% cream, gabapentine 100 mg/d PO and liberal use of

Figure 2. Eczematous plaques lateral to the healed linear midline incision over both knees after total knee replacement surgery. The eczematous plaque is larger over left knee compared to that on the right knee reflecting anatomical variations of infrapatellar nerve between the two limbs in the same patient.

bland emollient cream given over 2 months was remittive. The hypoesthesia and skin lesions had resolved completely without recurrence at a follow up of more than one year.

Discussion

Iatrogenic injury to the IPbSN can occur during many knee surgical procedures, total knee replacement surgery being one of the most commonly performed world over. Its subcutaneous location and multiple anatomical variations in its course perhaps make it more susceptible to iatrogenic injury. It gets injured in 85% to 100% of cases with standard surgical approach of midline skin incision with medial parapatellar arthrotomy for TKR [3, 14-17]. However, injury to IPbSN may also follow knee arthroscopies especially when bone-patellar tendon bone grafts are used for cruciate reconstructions or rarely during antero-medial portal placement or hamstring harvests [15].

An area of altered sensations varying from mild paresthesia to complete anesthesia results from transection of IPbSN lateral to the incision spread over the skin innervated by it [3]. Few cases may develop cutaneous lesions in this area with altered sensation ranging from a subtle rash to a highly pruritic, excoriated patch of eczematous dermatitis [5-10, 16]. Similar skin lesions following surgical nerve injury after arthroscopic debridement of medial meniscal cyst, various flap surgeries, and scar site of saphenous vein graft harvest for coronary artery bypass grafting have been described under varied nomenclature such as post-traumatic eczema, trophoneurosis, sympathetic dysfunction dermatitis, neuropathic dermatitis or autonomic denervation dermatitis, and postulated to be a type of self-limiting “traumatic eczema” [5, 7-10, 18]. Verma and Mody in 2009 reported similar skin lesions occurring 3 weeks to 4 months after TKR in 55 patients and proposed the nomenclature “SKINTED” advocating that it be considered site- and procedure-specific diagnosis associated with TKR surgery [7]. SKINTED responds well to treatment with topical corticosteroids and is self-limiting with no further recurrences. Our patient also showed more or less similar clinical features and therapeutic outcome.

Guiding opinions

There are no established diagnostic criteria and the diagnosis of SKINTED mainly remains clinical. The histological features of mild epidermal hyperkeratosis with focal basal vacuolar degeneration and perivascular infiltrate of lymphocytes and few eosinophils in superficial dermis and no acute inflammatory cells or demonstrable microorganism in some studies suggestive of a non-specific subacute spongiotic dermatitis are not pathognomic and a skin

biopsy is usually not recommended for diagnosis [4, 9, 10, 19].

Surgical site allergic contact dermatitis, surgical wound infection, and allergy to metal implant are common differentials. Allergic contact dermatitis usually presents acutely within 1-2 weeks as intensely pruritic, oozy eczematous lesion whereas surgical site infection will show classic signs of acute infection/inflammation such as fever and local pain, warmth, and purulent discharge from the wound. Metal hypersensitivity is rare complication of TKR and typically presents with periprosthetic synovitis and swelling. Whereas, eczematous dermatitis from an implant is rare, usually seen 2 months to 2 years postoperatively, and is localized mostly on both sides of the scar or may be wide spread involving neck, buttocks, and extremities (systemic contact dermatitis), recurrences are frequent and may require removal of implant. In contrast, SKINTED lesion is localized to lateral to the scar, less pruritic and is mostly self-limiting.

Although IPbSN injury is relatively common in any knee surgery, only a few patients develop skin lesions. Involvement of both knees is uncommon and was noted in only six of 69 patients in a review [11]. This has been conjecturally attributed to the extent of nerve damage, for instance, a larger incision for TKR combined with some crushing injury to the nerve due to retraction may lead to higher chances of nerve injury and skin lesions compared to a relatively smaller incision in other knee surgeries [11]. Whereas, anatomical variations of this nerve in different patients and also between the two limbs in the same patient resulting in damage to the nerve in one knee being more than on the opposite side has been posited to explain that why IPbSN injuries do not always lead to skin eruptions in all patients or why it is mostly unilateral/asymmetric in patients even having undergone bilateral TKR [2, 7].

The mechanism of such skin eruptions occurring in patients with compromised innervation remains speculative and few studies have attempted to elucidate the underlying pathophysiology. Satku et al [6] who first described this unusual complication of TKR in three patients posited that loss of sensory and autonomic function might be responsible for neuropathic dermatitis. Another view suggests that disruption of the autonomic constituents of the skin probably alters cutaneous sweat gland function, vasomotor activity and skin microcirculation causing aberrant differentiation, proliferation and functioning of keratinocytes leading to these eruptions [9]. The disruption of acetylcholine and catecholamines released from autonomic nerve endings, which also play an important role in keratinocyte functioning, perhaps also play an important role in its pathogenesis [20, 21]. Verma and Mody [7] also postulated that increased transepidermal water loss because of altered barrier function of the epidermis from surgical trauma to the superficial nerves causes xerosis which eventuates to pruritc eczematous dermatitis. They also imputed it to altered ability of keratinocytes due to nerve injury to maintain an intact epithelial barrier with the support of the nerves secreting neuropeptides including substance P and acetylcholine or absence of their regulatory influence on inflammatory process. The neuropeptides such as calcitonin gene-related peptide, substance P, vasoactive intestinal peptide, neurotensin, and other neuropeptides, which are involved in antigen presentation during hypersensitivity reactions and skin inflammatory cascade, are released from nerve terminals during the process of nerve regeneration; this can be another potential mechanism [8, 22]. The development of rash almost after the healing of incision in most patients when there is regeneration of injured nerves also supports this hypothesis. Another interesting postulated pathomechanism put forth is that SKINTED, which involves trauma to nerves as well as regional lymphatics, is a classic example of an immunocompromised districts (ICD) [23, 24]. The concept of ICD has been proposed for vulnerability and propensity to develop another unrelated disease at the site of a local/regional altered immunity (dysimmunity) from previous injuries (trauma including from surgical, radiation, burns, and amputations, chronic microscopic or macroscopic lymphatic stasis, healed herpetic infections, vaccinations, and even paralytic stroke or poliomyelitis) offering little resistance [24]. This is akin to earlier concept of “locus minoris resistentiae” meaning thereby “an area, site, structure or organ of lessened resistance, genetically inherited or acquired, offering little resistance to invasion by microorganisms and/or their toxins” [25, 26]. This sectorial immune dysregulation in an ICD is

said to be due to locally dysfunctional lymphatic drainage affecting transportation of immunocompetent cells and damage to sensory nerves that release immunity-related peptides responsible for neurotransmitter signaling to cell membranes of immunocompetent cells, or both [27, 28]. Apparently, in an otherwise immunocompetent individual skin does not quickly forget its previous injuries no matter how normal it appears and this memory including immunologic memory may last for life.

Although autonomic neuropathy primarily appears common to all, interestingly there seems no consensus at present in the published literature for pathophysiology involved and the nomenclature of this uncommon disorder. The "post traumatic eczema" that develops at and around the trauma within 2-4 weeks of mechanical, thermal, chemical injury remains non-specific terminology as all traumas do not cause eczematous lesions. In contrast, "ADD" usually takes months to years to develop at and around surgical sites irrespective of the site and nature of surgical procedure and differs from "SKINTED" which is considered to be site- and surgical procedure-specific dermatosis. We tend to agree to the suggestion of Verma and Mody [7] and feel that nomenclature *SKINTED* is more apt to describe this unique entity associated with TKR whereas similar phenomenon observed following other surgical procedures can be labeled as *autonomic denervation dermatitis* for uniformity sake [5, 7-10, 18]. Nevertheless, our viewpoints are open to debate as much needs to be learned especially at the molecular level to further our understanding of the underlying mechanism(s) of this uncommon entity. Well-designed and more comprehensive future studies may resolve the issues related to its underlying pathophysiology and nomenclature.

Although for its self-limiting clinical course long-term prognosis is good and knee function per se is not affected significantly, the eruptions may lead to dissatisfaction, undue stress and mental agony for the patients. This could even cause some deficiency in the rehabilitation of the knee that can hamper recovery [29]. Thus, minimizing the iatrogenic injury to the nerve during knee surgery remains a primary preventive measure. As the nerve moves distally with flexion of the knee, the anterior incision can be made initially with the knees flexed to avoid the damage to IPbSN [30]. Alternatively, medial parapatellar approach such as lateral arthrotomy, anterolateral skin incisions, and careful dissection of nerve in the subcutis as well as avoiding undue pressure from the medial retractor will minimize the chances of injury to the nerve during TKR [3, 31, 32]. Use of classical or modified oblique incision instead of vertical or horizontal incision for hamstring graft harvesting, and harvesting of only semitendinous instead of bitendinous (semitendinous and gracilis) grafts in ligament reconstruction surgeries have been suggested to minimize the nerve injury [29, 33].

Conclusion

SKINTED is a rarely reported postoperative complication of TKR. Although it does not influence the postoperative course or compromise knee function, its occurrence could be a cause of unnecessary worry and dissatisfaction for the patient. It might also be a source of stress and apprehension for the operating surgeons who may not be aware of its possibility. Since its diagnosis is mainly clinical, an astute observation for early recognition and counseling for its benign self-limiting clinical course remains imperative. Any patient presenting with the typical lesions of well-defined erythematous, eczematous and/or scaly plaques with or without crusting and itching especially corresponding to area of concurrent or previous hypoesthesia after knee surgery should raise suspicion of SKINTED. Preventive measures to minimize the iatrogenic injury to the nerve, preoperative counseling, adequate postoperative monitoring and timely dermatological referral for diagnostic evaluation can achieve an overall satisfactory outcome. However, well defined diagnostic criteria/tools and treatment protocols remain highly desirable.

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Disclosure of conflict of interest

None.

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References

[1] Kartus J, Ejerhed L, Eriksson BI and Karlsson J. The localization of the infrapatellar nerves in the anterior knee region with special emphasis on central third patellar tenden harvest: a dissection study on cadaver and amputated specimens. Arthroscopy 1999; 15: 577-586.

[2] Ebraheim NA and Mekhail AO. The infrapatellar branch of saphenous nerve: an anatomical study. J Orthop Trauma 1997; 11: 195-199.

[3] Ackmann T, Von Düring M, Teske W, Ackermann O, Müller P and Von Schulze Pellengahr C. Anatomy of the infrapatellar branch in relation to skin incisions and as the basis to treat neuropathic pain by percutaneous cryodenervation. Pain Physician 2014; 17: E339-E348.

[4] Nazeer M, Ravindran R, Katragadda BC, Muhammed EN, Rema DTJ and Muhammed MN. SKINTED: a rare complication after total knee arthroplasty. Arthroplast Today 2020; 6: 1028-1032.

[5] Pathania YS and Singh S. SKINTED: an autonomic denervation dermatitis. Int J Dermatol 2020; 59: 613-614.

[6] Satku K, Fong PH, Kumar VP and Lee YS. Dermatitis complicating operatively induced anesthetic regions around the knee. A report of four cases. J Bone Joint Surg Am 1993; 75: 116-118.

[7] Verma S and Mody B. Explaining a hitherto nameless condition: 'SKINTED'. Clin Exp Dermatol 2009; 34: e465-e466.

[8] Sharquie KE, Noaimi AA and Alaboudi AS. Neuropathy dermatitis following surgical nerve injury. Case Rep Dermatol Med 2011; 2011: 234185.

[9] Madke B, Mhatre M, Kumar P, Singh AL and Patki A. Autonomic denervation dermatitis: a new type of eczematous dermatitis. Clin Dermatol Rev 2017; 1: 61-64.

[10] Barbera J, van der Ven A and Amjad I. Bilateral neuropathy dermatitis following simultaneous bilateral total knee arthroplasty: a case report. JBJS Case Connect 2018; 8: e23.

[11] Dhillon MS, Jindal K, Shetty VD, Kumar P and Rajnish RK. Autonomic denervation dermatitis: a relatively undocumented 'ADD'itional complication of total knee replacements and other surgeries around the knee. Indian J Orthop 2021; 55: 1068-1075.

[12] Chalmers BP, Melugin HP, Sculco PK, Schoch JJ, Sierra RJ, Pagnano MW, Stuart MJ and Taunton MJ. Characterizing the diagnosis and treatment of allergic contact dermatitis to 2-octyl cyanoacrylate used for skin closure in elective orthopedic surgery. J Arthroplasty 2017; 32: 3742-3747.

[13] Mahajan VK, Mehta KS, Chauhan PS, Sharma R, Sharma A, Verma YR, Chandel M, Sharma H, Sharma J, Singh VK and Hooda S. Clinical, occupational and allergological profile of 455 patients with occupational contact dermatitis: a 5-year study from a tertiary care center of north India. Indian Dermatol Online J 2021; 12: 541-548.

[14] Kalthur SG, Sumalatha S, Nair N, Pandey A, Sequeria S and Shobha L. Anatomic study of infrapatellar branch of saphenous nerve in male cadavers. Ir J Med Sci 2015; 184: 201-206.

[15] Kerver AL, Leliveld MS, den Hartog D, Verhofstad MH and Kleinrensink GJ. The surgical anatomy of the infrapatellar branch of the saphenous nerve in relation to incisions for anteromedial knee surgery. J Bone Joint Surg Am 2013; 95: 2119-2125.

[16] Mistry D and O'Meeghan C. Fate of the infrapatellar branch of the saphenous nerve post total knee arthroplasty. ANZ J Surg 2005; 75: 822-824.

[17] Laffosse JM, Potapov A, Malo M, Lavgne M and Vendittoli PA. Hypesthesia after anterolateral versus midline skin incision in TKA: a randomized study. Clin Orthop Relat Res 2011; 469: 3154-1163.

[18] Dhopte A, Patil S, Barde N, Thakre R, Harsh S and Nisal S. Sympathetic dysfunction dermatitis in a revascularized upper extremity after near total amputation - A case report and review of literature. Indian J Plast Surg 2018; 51: 327-330.

[19] Mathur D and Sharda S. Autonomic denervation dermatitis in two patients. Indian J Clin Dermatol 2019; 2: 96-97.

[20] Nomura T, Yoshida-Amano Y, Yoshida K, Fujii A, Tanahashi M, Sugiyama Y, Iwata K and Murase T. Relationship between trans-epidermal water loss, cutaneous microcirculatory function and autonomic nervous activity. Int J Cosmet Sci 2017; 39: 275-283.

[21] Cassler NM, Burris AM and Nguyen JC. Asteatotic eczema in hypoesthetic skin: a case series. JAMA Dermatol 2014; 150: 1088-1090.

[22] Kato N and Ueno H. Saphenous vein graft donor site dermatitis in Japan. J Dermatol 1995; 22: 681-685.

[23] Verma SB. Adding 'SKINTED' to the list of immunocompromised districts. Clin Exp Dermatol 2020; 45: 346-347.

[24] Verma SB. What's in a name? Surgical incision sites are potential immunocompromised districts. Int J Dermatol 2019; 59: e23-e26.

[25] Tüzün Y, Işçimen A, Göksügür N, Demirkesen C and Tüzün B. Wolf's isotopic response: trichophyton rubrum folliculitis appearing on a herpes zoster scar. Int J Dermatol 2000; 39: 766-768.
[26] Sharma RC, Sharma NL, Mahajan V and Sharma A. Wolf's isotopic response: herpes simplex appearing on scrofuloderma scar. Int J Dermatol 2003; 42: 664-666.
[27] Ruocco V, Brunetti G, Puca RV and Ruocco E. The immunocompromised district: a unifying concept for lymphoedematous, herpes-infected and otherwise damaged sites. J Eur Acad Dermatol Venereol 2009; 23: 1364-1373.
[28] Ruocco V, Ruocco E, Piccolo V, Brunetti G, Guerrera LP and Wolf R. The immunocompromised district in dermatology: a unifying pathogenic view of the regional immune dysregulation. Clin Dermatol 2014; 32: 569-576.
[29] Bourne RB, Chesworth BM, Davis AM, Mahomed NN and Charron KD. Patient satisfaction after total knee arthroplasty: who is satisfied and who is not? Clin Orthop Relat Res 2010; 468: 57-63.
[30] Tifford CD, Spero L, Luke T and Plancher KD. The relationship of the infrapatellar branches of the saphenous nerve to arthroscopy portals and incisions for anterior cruciate ligament surgery: an anatomic study. Am J Sports Med 2000; 28: 562-567.
[31] Maniar RN, Singhi T, Nanivadekar A, Maniar PR and Singh J. A prospective randomized study in 20 patients undergoing bilateral TKA comparing midline incision to anterolateral incision. J Orthop Traumatol 2017; 18: 325-333.
[32] Tsukada S, Kurosaka K, Nishino M and Hirasawa N. Cutaneous hypesthesia and kneeling ability after total knee arthroplasty: a randomized controlled trial comparing anterolateral and anteromedial skin incision. J Arthroplasty 2018; 33: 3174-3180.
[33] Zhu B, Li X and Lou T. Modified oblique incision in hamstring tendon graft harvesting during ACL reconstruction. J Orthop Surg Res 2021; 16: 206.