Many surgeries are scheduled surgeries, and specific disorders including spinal vascular diseases and spinal intramedullary tumors require a highly professional surgeon. Surgeons with unexpected injuries have a profound effect on patients and their own institutes. Here we describe a special technique for performing surgery in the standing position despite an injury, used by a surgeon with an Achilles tendon rupture. His experience with this technique indicates that stable surgery performance is possible using genuflection and the product ‘Surgical Body Support’ (SBS; Takano, Nagano, Japan; https://www.takano-net.co.jp). The SBS was developed for use by standing surgeons. It consists mainly of a lumbar support and armrest. The lumbar support is designed to support the body’s trunk, and the armrest is effective for stable operation with less fatigue.

Methods

This is a ‘technical note’ document that will be of interest to surgeons who have a leg, ankle or foot injury. The surgeon (T.Y.) performed surgeries while keeping weight off his left ankle for the 45-day non-weight-bearing period that he had to undergo after surgery for an Achilles tendon rupture. The intraoperative electromyogram of the standing surgeon’s right lower leg was also examined in order to identify the load difference in several settings using left leg genuflection and the SBS.

The amplitude of 20 randomly selected waves from the right anterior tibial muscle and gastrocnemius muscle were compared with [1] the use of neither of...
genuflection nor SBS, [2] the use of only genuflection, and [3] the use of both genuflection and SBS. We used a one-factor analysis of variance (ANOVA) to analyze the data, and p-values < 0.05 were considered significant. The data are presented as the mean ± standard error.

Results

On June 21, 2015, the surgeon T.Y. accidentally ruptured the Achilles tendon of his left ankle. He underwent an achillorrhaphy on the same day as the injury, and he was instructed to keep weight off the left ankle for 45 days. He returned to his routine work the next day. At that time, he had 5 scheduled spinal surgeries including those for spinal vascular diseases. Spinal vascular diseases and spinal intramedullary tumors are always treated by this surgeon in our neurosurgical department. The surgeon’s circumstances were explained to the 5 patients scheduled for the surgeries, and they were asked whether they wanted another surgeon to perform the surgery. The surgeon clearly explained that his condition was not perfect and that the surgical time might be longer than usual. One patient with lumbar spinal stenosis chose to delay the surgery, and the other four patients chose to undergo the surgery as scheduled because of their rapidly deteriorating symptoms, their good doctor-patient relationship and their previously scheduled plans. After a thorough explanation of the surgical situation, all 4 of these patients completely agreed that surgeon T.Y. would perform their surgeries.

The first 2 surgeries were performed with the surgeon using only left genuflection on a chair (Fig. 1A–C). The knee was protected with a gel pad and sponge on the chair. The genuflection made it possible for the surgeon to remain standing and perform surgery for a few hours. If he needed to take a rest, he could sit for a few minutes and then return to the operation. For bipolar coagulation and drilling, an assistant used the foot switch in response to the surgeon’s instructions of ‘On’ and ‘Off.’ After his third surgery, the surgeon

Fig. 1  Genuflection and the SBS. Upper column: Surgery only with genuflection. The knee was protected with a gel pad (A) and sponge on the chair (B). A picture from the back taken during surgery (C). Lower column: Surgery with both genuflection and the SBS. Combination of genuflection and the SBS (D–F).
used the SBS in addition to genuflection (Fig. 1D–F).

During the 45 days in which he kept weight off his left ankle, the surgeon participated in a total of 15 surgeries as an operator or assistant. He performed 8 scheduled spinal surgeries and one emergent spinal surgery in the standing position as an operator. The surgery for cases with spinal vascular disease and spinal intramedullary tumors required special neurosurgical techniques. An emergency surgery was performed for a patient suffering from intramedullary cavernoma with severe paraparesis, after a discussion with orthopedic surgeons. As an assistant, the surgeon performed 3 scheduled neurosurgical procedures and 3 emergent surgeries. The durations of all 15 surgeries and the amounts of bleeding were consistent with the usual values.

The amplitude of the intraoperative electromyogram results from the surgeon’s right anterior tibial muscle and gastrocnemius muscle showed that the load on the lower leg was lowest during the surgery when both genuflection and the SBS were used, and the highest load was observed during the surgery with neither genuflection nor the SBS (Figs. 2, 3). There were significant differences in the electromyogram amplitude of the anterior tibial muscle and gastrocnemius muscle. Upper column: There were significant differences in the amplitude of the electromyogram results from the anterior tibial muscle with and without genuflection. Lower column: There were significant differences in the electromyogram amplitude results in the gastrocnemius muscle in all settings.

Fig. 2 Intraoperative electromyogram at various situations. A, An intraoperative photo of the surgeon with needle electrodes; B–D, Intraoperative electromyograms of the surgeon with neither genuflection nor the SBS (B), with only genuflection (C) and with both genuflection and the SBS (D).

Fig. 3 Amplitudes of the surgeon’s electromyogram from the right anterior tibial muscle and gastrocnemius muscle. Upper column: There were significant differences in the amplitude of the electromyogram results from the anterior tibial muscle with and without genuflection. Lower column: There were significant differences in the electromyogram amplitude results in the gastrocnemius muscle in all settings.
amplitude of the anterior tibial muscle between the periods with and without genuflection, but there was no significant difference between the combination of genuflection and SBS and genuflection only (genuflection and SBS: 5.9±0.6 μV; genuflection only: 31±4.9 μV; neither genuflection nor SBS: 184±21 μV).

There were significant differences in the amplitude of the results from the gastrocnemius muscle in all settings (genuflection and SBS: 21±3.3 μV; genuflection only: 103±17 μV; neither genuflection nor SBS: 432±32 μV).

**Discussion**

We described the experiences of a surgeon who used a standing position to perform surgery during a 45-day recovery period following his own achillorrhaphy for an Achilles tendon rupture. With the use of both genuflection and the SBS, the surgeon was able to perform surgeries almost the same as usual. The SBS, which has excellent ergonomics, is useful for a surgeon with an injured leg.

This is the first report that reveals how a surgeon can overcome a leg or ankle injury and successfully complete scheduled and emergent surgeries. Surgeries can often be re-scheduled, or other reliable surgeons can perform a scheduled surgery if the patient agrees. However, if the patient would like the injured surgeon to perform the surgery, our present analysis indicates that the combination of genuflection of the injured leg on a stool and use of the SBS can be a good option. We observed that the electromyograms taken during surgery with genuflection and/or the SBS showed that the combined use of genuflection and SBS reduced the burden of standing on the healthy leg during surgeries.

The SBS was originally developed to improve maneuverability and reduce the musculoskeletal load in the standing position during surgical procedures [1]. A three-axis accelerometer and surface electromyography attached to the surgeon/SBS user showed increased body stability, improved motion smoothness and a 70% reduction in musculoskeletal loading [1].

The advantages of using the SBS for surgery are a reduction in the load on the lower limbs and a stable platform provided by placing both arms on the rest. However, a disadvantage of the SBS is the difficulty in seeing and operating on the surgeon’s near side. Surgery in a sitting position is another option [2]. The lateral oblique position enables the surgeon to perform surgery in a sitting position. This position meets the requirement for both spinal stabilization and abdominal pressure reduction, with less blood loss and a better operative field [3]. However, the lateral position or oblique position might initially be difficult for surgeons who are unaccustomed to this position. The setting should be carefully prepared in advance. It might be difficult to determine the correct dissection plane and to recognize the correct area and angle to be drilled.

In conclusion, this is the first report to show how a surgeon with an injured leg can perform surgeries in the standing position. A combination of genuflection of the injured leg on a stool and the SBS is helpful in this situation. An accidental leg injury can happen to any surgeon, and this method, along with an attitude to “never to give up,” will be useful for surgeons in this rare situation.

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**References**