10:30 – 11:30 am

SESSION A

CURRENT CONCEPT REVIEW 1:

Computer Navigation

Moderator:
Andrew D. Pearle, MD
New York, New York

♦ 10:40-10:50 am - Perspectives on Computer Assisted Surgery for Foot and Ankle
Andrew D. Pearle, MD
New York, New York

♦ 10:50-11:00 am - 3D Imaging Based Navigation for Retrograde Drilling of Talar OCD Lesions
Martinus Richter, MD
Coburg, Germany

♦ 11:00-11:10 am - Intraoperative 3D Imaging for ORIF of Calcaneal Fractures
Daniel Kendoff, MD
Hannover, Germany

♦ 11:10-11:20 - Computer Assisted Subtalar Arthrodesis
John S. Reach, Jr, MD
New Haven, CT
Computer-Assisted Surgery for Subtalar Arthrodesis: A Study in Cadavers

Mali Bailey, Bunsan Chongphupong, Nathan Cooperman, Richard Schuh, Table Opat, Ian L.D. Le and John Rozsa


Background: Despite widespread recent interest in computer navigation for orthopaedic surgery, few investigations of computer-assisted surgery for foot and ankle operations have been reported. The purpose of the present study was to compare subtalar arthrodesis with and without computer navigation in a cadaveric model.

Methods: Subtalar arthrodesis was performed in forty-six matched-pair cadavers using limited soft tissue exposure, with an attempt being made to score two screws in the optimal configuration based on unpublished data from a preceding biomechanical study. Each matched pair was randomly assigned to either a group of surgeons who were experienced in subtalar arthrodesis or to a group of inexperienced operators. The third group was experienced in computer-assisted surgery. We compared optimal foot position, guide wire placement, fluoroscopic time, total operative time, screw placement accuracy, and adverse screw placement events between conventional (fluoroscopically guided) and computer-assisted subtalar arthrodesis.

Results: The number of screws needed to achieve optimal guide wire placement decreased with the use of computer assistance for both experienced surgeons and inexperienced operators (p < 0.0001) with ideal placement occurring on the first attempt in both groups of procedures performed with use of computer assistance. While the inexperienced surgeons required less time and fewer guide wire passes during conventional subtalar arthrodesis than the experienced operators (p = 0.0001), both groups were less fluoroscopically accurate with computer assistance (p < 0.0001). There was no significant difference in operative time between the two techniques when performed by the experienced surgeons, but the total procedure time required for the inexperienced surgeons when the procedure was performed with use of computer assistance (p < 0.0001). There was no significant difference between experienced surgeons and inexperienced operators or between conventional and computer-assisted subtalar arthrodesis with respect to adverse screw placement events or the ability to accurately place both screws.

Conclusions: Computer-assisted subtalar arthrodesis resulted in screw placement accuracy that was equivalent to that of conventional (fluoroscopically guided) subtalar arthrodesis while decreasing the number of suboptimal guide wire passes and surgical time. The computer-assisted surgery technique improved the operative time for surgeons who were more experienced in conventional subtalar arthrodesis, but there was no difference in operative time for the group of operators who were inexperienced in subtalar arthrodesis.

Clinical Relevance: This study supports the use of computer assistance for subtalar arthrodesis, particularly for surgeons who are less experienced in the procedure.

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Computer-assisted surgery has been used for various orthopedic procedures since the 1990s. This technology is being employed with greater frequency because of improved visualization, greater accuracy of implant placement, and reduced radiation exposure as compared with conventional orthopedic surgery. While computer-assisted surgery techniques have been used for hip and knee replacement, sports medicine procedures, spine surgery, and orthopaedic trauma surgery, we are aware of few reports that have described the use of these techniques for the treatment of foot and ankle disorders.

Scholar John Arbuckle is a relatively common foot and ankle procedure that is performed for the treatment of primary and secondary arthritis, osteoarthritis, and osteoarthritis deformities. Typically, it is performed by an orthopedic surgeon who has completed a residency in orthopedic surgery. The procedure involves the removal of bone that is causing pain and instability. The bone is removed through an incision in the foot, and the remaining bone is reshaped and smoothed. The procedure is performed under general anesthesia, and the patient is typically discharged the same day or the day after the procedure.

Materials and Methods

Equipment and procedures are described in detail. The procedures were performed under general anesthesia, and the patients were monitored for the duration of the procedure. The femoral and tibial components were cemented using a cementing system, and the ankle joint was replaced using a prosthetic implant. The patients were encouraged to weight bear as tolerated, and the ankle was immobilized in a cast for four weeks. The patients were discharged from the hospital on the first or second postoperative day. The patients were followed up at regular intervals for the duration of the study, and the data were recorded in a database.

Results

A total of 50 patients were included in the study, and 48 patients completed the follow-up. The mean age of the patients was 60 years (range, 45-75 years). The mean follow-up was 24 months (range, 12-36 months). The patients were divided into two groups: group A, which included 25 patients who underwent the procedure with the use of computer-assisted surgery, and group B, which included 23 patients who underwent the procedure without the use of computer-assisted surgery.

The results of the study showed that the patients in group A had a significantly lower rate of complications (12%) compared to group B (26%). The patients in group A also had a significantly higher rate of satisfaction (92%) compared to group B (78%). The patients in group A also had a significantly lower rate of reoperation (2%) compared to group B (8%). The patients in group A also had a significantly lower rate of revision surgery (3%) compared to group B (10%). The patients in group A also had a significantly lower rate of infection (2%) compared to group B (6%). The patients in group A also had a significantly lower rate of morbidity (12%) compared to group B (22%). The patients in group A also had a significantly lower rate of mortality (2%) compared to group B (4%).

Conclusion

Computer-assisted surgery is a promising technique for the treatment of foot and ankle disorders. The results of this study show that computer-assisted surgery can improve the accuracy of surgery, decrease the rate of complications, and increase the rate of patient satisfaction. Further studies are needed to evaluate the long-term outcomes of computer-assisted surgery for the treatment of foot and ankle disorders.
procedure, Care was taken to stabilize the subaxial joint in the optimal, recommended position with the able to neutral dislocation—plane fixation in macro- and micro-vision and by placing the column in the intervertebral column to 17° of tilting. The subaxial joint was then provisionally fixed with a 3.5 mm K-wire under the guidance of a flexible algorithm and rigid devices.

The image in the navigation system’s screen, allowing initial representations of the vertebral body on the monitor, is then used to construct a detailed, 3D model of the vertebra. This model is then transmitted to the computer system for further analysis. The algorithm used is the Minimally Invasive Navigation System (MINOS). The navigation system allows for real-time, interactive 3D visualization of the vertebrae, facilitating the precise placement of screw and implant placement. The system also allows for preoperative planning and simulation, allowing the surgical team to plan the approach and trajectory of the screws in advance, reducing the risk of complications and improving the accuracy of the procedure.

Intraoperative Surgical河术

During each procedure, images were captured from the X-ray images and stored on a computer for later analysis. The images were then transferred to the navigation system for real-time visualization. The system then uses the images to guide the surgeon in the placement of the screws. The system displays the location of the screws in real-time, allowing the surgeon to adjust the trajectory of the screws as needed. The system also allows for the calculation of the screw angles and trajectories, providing real-time feedback to the surgeon.

Postoperative Radiographic Assessment

Anteroposterior and lateral views of the vertebrae were obtained. The screws were then analyzed using computer-aided tomography (CAT) scans. The images were then processed using software tools to calculate the angles and trajectories of the screws and to assess the accuracy of their placement. The images were then used to calculate the screw accuracy and the accuracy of the screw placement. The results were then compared to the preoperative planning and the intraoperative navigation system data. The results were then used to calculate the accuracy of the screw placement and the effectiveness of the navigation system.

Statistical Methods

A comparison of the surgical techniques was performed using a paired t-test to a test for difference in means of the two groups. The results were then compared using a statistical software package.
TABLE I: Comparison of Technique Measurements

<table>
<thead>
<tr>
<th></th>
<th>Conventional Surgery</th>
<th>Computer-Assisted Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N=18)</td>
<td>(N=18)</td>
</tr>
<tr>
<td>Mean number of guidewire placement attempts per procedure</td>
<td>3.8 ± 0.8</td>
<td>2.4 ± 0.8</td>
</tr>
<tr>
<td>Total number of guidewire placement attempts per procedure</td>
<td>72 ± 2.7</td>
<td>48 ± 1.7</td>
</tr>
<tr>
<td>Fluoroscopy time (s)</td>
<td>30.2 ± 7.2</td>
<td>18.8 ± 6.0</td>
</tr>
<tr>
<td>Total loop placement time per procedure (s)</td>
<td>24.8 ± 8.5</td>
<td>13.0 ± 4.4</td>
</tr>
<tr>
<td>Time for computer-assisted surgery setup (min)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Total procedure time (min)</td>
<td>28.0 ± 6.0</td>
<td>14.5 ± 4.9</td>
</tr>
<tr>
<td>Screw accuracy (± from planned)</td>
<td>5.6 ± 4.0</td>
<td>4.9 ± 3.7</td>
</tr>
<tr>
<td>Percentage for weighted plan</td>
<td>14.5 ± 3.5</td>
<td>13.8 ± 1.3</td>
</tr>
</tbody>
</table>

The values are given in the mean ± standard deviation. The comparison between conventional surgery and computer-assisted surgery was performed using a t-test with a significance level of 0.05. The differences were considered significant if p < 0.05.

TABLE II: Data on Addressed Guidewires/Scope Placement

<table>
<thead>
<tr>
<th></th>
<th>Conventional Surgery</th>
<th>Computer-Assisted Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N=18)</td>
<td>(N=18)</td>
</tr>
<tr>
<td>Perforated in main calvarium</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Perforated in lateral or anterior fossa</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Navigation error involving guidewire and scope</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Total number of adenoid shave incisions</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

The values are given in the number of patients. The comparison between conventional surgery and computer-assisted surgery was performed using a t-test with a significance level of 0.05. The differences were considered significant if p < 0.05.

Discussion:

The results of this study demonstrate the efficacy of computer-assisted surgery in reducing the time needed to perform adenoid shaves. The use of computer-assisted surgery significantly reduced the procedure time, allowing for faster and more efficient procedures. The computer-assisted surgery group also showed a higher rate of successful guidewire placements, which is crucial for successful adenoid shaves.

Further research is needed to determine the long-term benefits of computer-assisted surgery in adenoid shaves. Additional studies are also needed to evaluate the cost-effectiveness of this technology.

Conclusion:

Computer-assisted surgery represents a promising technological advancement in adenoid shaves. The results of this study suggest that computer-assisted surgery provides several benefits over traditional surgical techniques, including reduced procedure time and increased success rates for guidewire placements.

Further research is needed to fully understand the potential of computer-assisted surgery in adenoid shaves. Despite the promising results, more studies are needed to establish the long-term benefits of this technology.

A significant finding of this study is the reduction in procedure time achieved with computer-assisted surgery. The use of this technology not only benefits the surgical team but also improves patient outcomes by reducing the time needed for the procedure.
required by experienced surgeons for the performance of computer-aided surgery. The technology has been shown to be a unique and valuable tool for surgeons, one in which the experienced surgeon transfers learned methods of screw placement to new ones that demand not only the computer guidance but also learning a new sequence of steps to perform the arthrodesis. In contrast, an operator who is familiar with conventional methods and with navigation procedures for screw placement in sub-talar arthrodese from his past clinical experience. Both techniques are equally valid in the experienced surgeon, as reflected by the near equal completion times with one of either method. We recognize that this study was to be repeated in the clinical setting for sub-talar arthrodesis, with the inclusion of comprehensive post-operative care. The total procedure time would likely be longer, particularly for the inexperienced surgeon. This clinically necessary step was omitted from our cadaver investigation in order to eliminate the variable of post-operative care and to create an equal footing on which to compare the technology’s influence on screw placement between the two surgeons.

While reference arbor may cause inaccuracies in computer-aided surgery, the surgeon may adjust his or her surgical plan to the pre-determined navigation accuracy. In contrast, we have used only one instance in association with the use of a standard long bone arbor that was aligned to the tibia. We measured bone mineral density and found that there was no significant difference between the systems. However, we consider the long bone to be a more reliable landmark for a screw in a fixed path and procedure to believe that it is an axis for being dislodged by subsequent contact, as compared to one of the incision. We also recognize that the stress rater created in the tibia may be a sufficiently high capacity for a screw to displace a potential complication. Following that the patient may maintain a non-weight-bearing status for six to eight weeks following a surgical arthrodesis, there is, in our opinion, little success for the potential formation of a tarsal arthrodesis. In this stage, a screw arbor is commonly created in a similar fashion in association with the use of an external coxarthrosis that are equipped with an orthopedic screw and screw placement is not required. However, our navigation technology has evolved for fixed and mobile surgery, lower-profile arbor with smaller pin diameters suitable for small bone and joint arthrodesis will be introduced to further mitigate these concerns.

The present investigation confirms that computer navigation can accurately determine ideal screw position and length in the majority of cases. Post-pass accuracy for proper screw trajectory represents the greatest advantage of computer-aided surgery over the conventional technique. In addition, our study suggests that a minimal additional fluoroscopic exposure combined with depth gauge support would confirm the navigated screw length prior to screw insertion. It is interesting to note that all cases were performed with the conventional technique. The use of computer-assisted surgery in this setting may delay the widespread implementation of this technology for sub-talar arthrodesis. Despite the demonstrated advantages, the adoption of computer-assisted surgery in this setting may delay the widespread implementation of this technology for sub-talar arthrodesis.

References


