No benefits with computer assistance in triple pelvic osteotomy

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ABSTRACT We evaluated computer-assisted surgery (CAS) used for 21 triple pelvic osteotomies on 20 patients with symptomatic acetabular dysplasia and compared the intraoperative and immediate postoperative data with those of 32 patients who underwent 40 pelvic osteotomies without CAS. The use of the CAS system was abandoned during 9/21 operations mostly because of technical and CT data failure. The peroperative blood loss and duration of surgery were greater, while neurovascular damage occurred less often in the CAS group. We found that the CAS system for pelvic osteotomy was not better than conventional methods.

Symptomatic acetabular dysplasia in a congruent hip joint without cartilage damage in a patient of 8 years or older can be treated with a pelvic osteotomy and acetabular reorientation. Various reorientation procedures of the acetabulum are in use (Salter 1961, Pemberton 1965, Steel 1973, Tönnis et al. 1981, Ninomiya 1984, Ganz et al. 1988). During these procedures, the orientation of the acetabulum is adjusted by means of pelvic osteotomies. In the November 2002 issue of this journal, a critical editorial was published concerning the use of computer—and robotic—assisted surgery. The author described the ideal situation for using computer—and robotic—assisted surgery: "the new techniques should result in more accurate and hopefully, less invasive surgery with a shorter operating time and fewer complications" (Toksvig-Larsen 2002). Currently, none of the published data have confirmed this statement except for the placement of pedicle screws in spinal surgery (Berlemann et al. 1997, Merloz et al. 1997, Schwarzenbach et al. 1997, Laine et al. 2000).

Langlotz et al. (1997, 1998) described the development of a computer assistance system (CAS) and briefly reviewed the results in 12 patients surgically treated for hip dysplasia using the system. To our knowledge no other articles concerning the clinical results of CAS in pelvic osteotomies have been published.

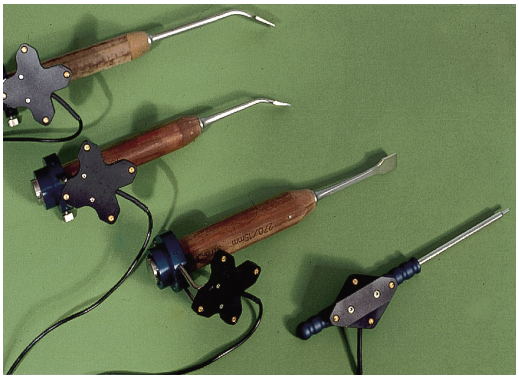
Since 1985, patients in our Department with hip dysplasia have been treated with triple pelvic osteotomies (de Kleuver et al. 1997) and in 1998 we started using the CAS system for pelvic osteotomies. As the first step in assessing the potential of CAS for pelvic osteotomies, we did an in vitro study in which the accuracy and usefulness of CAS were tested (van Hellemondt et al. 2002). We now report the use of the CAS-system in 21 triple pelvic osteotomies and compare the results with 40 osteotomies performed without it.

Patients and methods

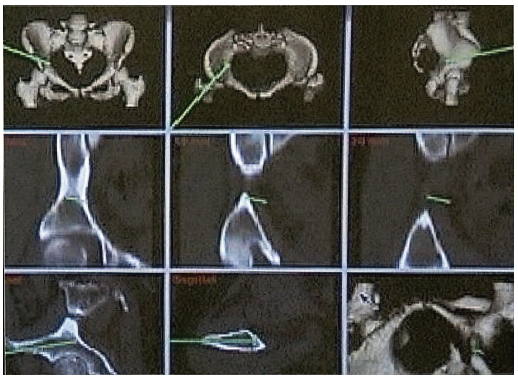
During June 1998 until February 2002 we (MK) performed 61 triple pelvic osteotomies on 52 patients with symptomatic congenital hip dysplasia. We divided these patients into two study groups. Group A was composed of 20 patients in whom 21 operations were performed using the CAS system.

During the same period, 40 operations were done on 32 patients without the CAS system (Group

A. The computer-assisted system: SurgiGATE system and OPTOTRAK 3020 optoelectronic localizer in the operating room.



B. Surgical instruments with the locating system mounted on the end.



C. View on the computer screen projecting the intraoperative data: preparing the ilium osteotomy

B). Patients who were referred to our department for symptomatic hip dysplasia and already had a CT scan were included into group B (Table). We thought that they would be exposed to too much radiation if they were given another preoperative CT scan, which is required when the CAS system is used. 8 of 52 patients were operated on bilaterally. Operating time, blood loss during the operation, body mass index (BMI), Wiberg angle (CE), Harris Hip Score (HHS) and the postoperative complications were recorded (Table).

The average postoperative follow-up was 30 (12–69) months. The CAS system used consists of the SurgiGATE hardware computer graphic workstation (Sun Microsystems Inc, Mountain View Ca) and an OPTOTRAK 3020 optoelectronic localizer (Northern Digital Inc, Waterloo, Ontario, Canada) (Figure). The statistical analysis, using the SPSS software, included an independent samples test (2-tailed $\alpha = 0.5$) and a one-way ANOVA test.

Results (Table)

Preoperative CE angles, HHS, BMI and the age of the patients were similar in the groups. We intended to use the CAS system during 21 operations, but in 9 patients continued withoud it. In this group, technical failure was the reason in 5 cases (cable dysfunction (1), software failure (3), light emitting diode failure (1), preoperative errors from the CT data which made it difficult to obtain a three-dimensional image of the pelvis (3 cases) and in 1 patient, the CAS system was not used because a pelvic osteotomy on the contralateral side disturbed the CT data. These patients were placed in group C during the data analysis.

A one-way ANOVA showed that the duration of the operation and the average blood loss differed in the three study groups ($p = 0.001$, $p = 0.02$).

A post hoc bonferroni comparison showed that the duration of the operation and blood loss in group A exceeded that in group B ($p = 0.001$, $p = 0.02$). The Wiberg (CE) angles after surgery were similar in the three groups (mean 34.7, 34.5 and 34.4 degrees).

Complications

The first patient who was operated on using the CAS system had to be a reoperated on because of overcorrection in the reorientation of the acetabulum.

Group A had fewer transient disturbances in the lateral femoral cutaneous nerve than groups B and

Data in patients

	Group A	Group B	Group C
Number of patients	12	32	8
Number of operations	12	40	9
Gender, female	9	28	7
Age, mean (range) yr [c]	26 (16–40)	32 (15–52)	29 (18–49)
Body mass Index (BMI), mean (range) [c]	24 (20–31)	23 (17–36)	24 (19–39)
Duration of surgery, mean (range) min [a, b]	103 (60–140)	78 (60–155)	89 (65–105)
Peroperative blood loss, mean (range) mL [a, b]	981 (450–2000)	573 (120–2500)	496 (110–1300)
Duration of hospitalization, days, mean (range) [c]	8.5 (4–14)	8.3 (3–30)	7.4 (5–10)
Wiberg (CE) angle, preop, mean (range) [c]	13 (0–22)	15 (–4–26)	11 (3–22)
Wiberg (CE) angle, postop, mean (range) [c]	35 (27–48)	35 (10–50)	34 (28–50)
Harris Hip Score, mean (range) [c]	66 (49–82)	70 (32–95)	75 (53–93)

[a] $p < 0.05$ difference between groups A,B and C (one-way ANOVA)
[b] $p < 0.05$ difference between groups A,B and C (post hoc bonferroni comparison)
[c] $p > 0.05$ difference between groups A,B and C (one-way ANOVA)

C (1/12 vs. 9/40 vs. 3/9). Two patients in group B had a temporary loss of sensation in the areas of the sciatic (pars peroneus) and genito-femoral nerves. There were no wound infections and all osteotomies healed.

Discussion

The CAS system gives the surgeon information about the anatomy of the bones, the osteotomies and the acetabular reorientation (Figure) so it should not be necessary to interrupt the procedure for intraoperative radiographs. An intraoperative radiograph is not standarized; it is a relatively poor two-dimensional representation of a three-dimensional object. Even standard radiographs are of questionable value (Harris 1969, Klaue et al. 1988, de Kleuver et al. 1998). Apart from the intraoperative information on the position of instruments, the CAS system provides a three-dimensional intraoperative image, which is of great value. The posterior coverage of the femoral head can be seen with a high spatial resolution CT scan (Klaue et al. 1988, Conway et al. 1996, Delaunay et al. 1997). Langlotz et al. (1997, 1998) briefly summarized the clinical findings in 12 patients who had been operated on using the CAS system during periacetabular osteotomies. Their findings accord with those of Berlemann et al. (1997) about the use of CAS during pedicle screw insertion and ours concerning pelvic triple osteotomies. This system is of little benefit if the surgeon is experienced. However, an inexperienced surgeon can improve his or her skills using the CAS system as a learning tool to master a technically demanding procedure.

In 9 of 21 cases, problems with the CAS system made us stop using it during the operation. We found that the procedures in which the CAS system was used, the duration of surgery and blood loss were greater than in the procedures without it. This increase in blood loss may be due to the longer operation which is necessary to become familiar with the CAS system and the time needed to position the CAS instruments. With experience, the duration of the operation may become shorter and the amount of blood loss may decline. We have found no reports on the use of the CAS system in pelvic triple osteotomy for comparison of our findings. The main advantages of the CAS system are that it permits preoperative planning of the procedure and gives the surgeons information which they can use during the operation. However, in our Department, we have much experience with pelvic osteotomy, and the use of the CAS system increased the length of operation and the intraoperative blood loss and did not improve the intraoperative and short-term results.

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