FEASIBILITY OF AUTOMATIC PRONE-SUPINE MATCHING IN CT-COLONOGRAPHY: PRECISION AND PRACTICAL USE

Authors: [1]A.H. de Vries, [2]R. Truyen, [2]J. van der Peyl, [1]J. Florie, [1]R.E. van Gelder, [2]F. Gerritsen, [1]J. Stoker.

Institution: [1]Department of Radiology, Academic Medical Centre, Amsterdam, the Netherlands [2]Philips Medical Systems, Best, the Netherlands.

Purpose: to study the feasibility of automatic prone-supine matching in CT-colonography using proven polyps.

Methods: In this study polyps were used as fixed points of reference, since anatomical points of reference (e.g. flexures) are mobile. Consecutive patients were selected from a comparative study of 3D colonography and colonoscopy comprising 249 patients at increased risk for colorectal cancer. The selected patients had a polyp that was proven at colonoscopy and detected in both prone and supine position. The size was 5 mm or larger in either colonoscopy or colonography. The determination of the status and linking of polyps in supine and prone position was done by consensus by two research fellows on morphology, size and segmental location of the polyp (reference standard).

Evaluation of automated supine-prone matching was done by using a prototype software tool based on the EasyVision workstation (Philips Medical Systems). The user interface panel showed both the supine and prone dataset in an Unfolded 3D rendering, 2D axial and in a volume rendered overview. Interactive navigation along the pre-calculated centerline was possible.
Matching of prone and supine datasets was done by aligning the centerlines using a global optimization criterion, resulting in an overall optimal alignment.
When the user navigated in one dataset (supine or prone) the virtual camera was placed on the corresponding point on the central axis of the other view.

The match error (in millimeters) was determined to measure the performance of the tool. For every polyp the distance between the calculated and the actual location of the corresponding polyp along the central axis (reference standard) was determined.

The practical use of the matching was determined by the ability of the tool to visualize the corresponding polyp as well as the time needed to indicate the corresponding polyp. The selected polyps in this study were shown one by one in the supine dataset. The corresponding location according to the tool was shown in the prone dataset. The reviewer reviewed the corresponding polyp in the prone position in 3D. The visibility of the polyp on the initial panel was measured on a four point scale: 1) polyp was instantly visible without flying through the colon, 2) polyp was initially visible as well but to be certain the reviewer had to fly through the colon 3) polyp was not visible in the initial panel, only after navigation and 4) no polyp was visible at all. If the polyp was classified under category 1 or 2 the match was considered successful. The time was measured from the moment the polyp was shown in supine position till the corresponding polyp in prone position was indicated.

Results: The study comprised 29 patients that had 37 polyps. The majority (25) of the included patients had one polyp, one patient had two, two patients had three and one had four polyps. The included polyps had a median size of 8 mm (maximum size 25 mm).
The average match error was 20 (range 0 - 59 mm) either forwards or backwards.
Seventy percent of the polyps were directly visible in the prone view (20 polyps in visibility category 1, 6 in category 2), the remaining 30% required some interaction to become visible. The median time needed to indicate the correct polyp was 104 sec (range 11-814 sec).
The time needed was negatively influenced by incorrect camera positioning in supine position in two polyps and thorough verification of the candidate matched polyps by the observer. The latter might be influenced by lack of familiarity with this new tool.

Conclusion
Automated prone-supine matching of CT-colonography studies is feasible and has a low match error.

Contact Information:
A.H. de Vries
Artsonderzoeker radiologie AMC
Meibergdreef 9
1105 AZ Amsterdam, the Netherlands
G1-226
Phone: +31 (0) 20-5663028
Email: ayso.devries@amc.uva.nl