Comparison of Planning Methods for Orthognathic Surgery Cases

Traditional Planning Methods vs Virtual Surgical Planning

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What is Orthognathic Surgery?

- Surgery to correct the occlusion and to change facial profile
- Involves controlled breaks of one or both jaws
- Jaws are then reset in new position which has been pre-planned
- Involves extended orthodontic treatment, followed by surgery, followed by further orthodontic treatment

- Now two main methods of planning – traditional or virtual
- Virtual offers opportunity to have orthodontics, or have the surgery first

Traditional Planning

- Planning done with 2D cephalometric analysis and manual manipulation of stone models
- Has been done this way since orthognathic surgery was introduced
- Higher levels of inaccuracy, reduced surgical outcomes, limited in surgery first approach
- Requires more time in terms of orthodontic appointments and laboratory staff

Virtual Surgical Planning

- Planning done with intra-oral scanning and CT scans
- Computer programmes used to plan movements, cutting lines, and plate and screw positioning
- High up-front cost, believed to become cost-effective over time
- Reduction in error and inaccuracy
- Improved surgical outcomes due to streamlined planning

Summary of Workflow Comparisons

	Traditional Workflow	Virtual Surgical Planning
Source of Data	Lateral Cephalogram Dental Stone Models	Cone Beam CT Intra-oral Scans
Surgery Model	Manual cutting and fixing of the stone models	Digital computed aided design modelling and simulations
Surgical Transfer	Intermediate and final splints/wafers	Computer Aided Design/Computer Aided Manufacture splints, cutting guides and patient-specific instruction
Soft Tissue	Estimated based on surgeon's previous experience	Accurate 3D simulations
Timeframe for Planning	Slow – manual manipulation of models	Much faster – planning done on computer programme

Pre-Surgery Appointments

- Traditional planning requires 18-24 months of pre-surgery orthodontics
- Visits every 4 to 6 weeks for adjustments, can lead to up to 24 visits
- Orthodontic appointments in Western Trust costs approx. £175
- Total cost can reach over £4000, £3150 on average

- VSP shows an average 4 appointment reduction – immediate £700 saving
- VSP also allows for surgery first approach
- Reduces appointments needed to only 2 – cost of only £350

Surgery Planning

- Traditional planning is labour and time intensive
- Costs include alginate impression material, dental stone, lab technician wages
- Single jaw surgery costs on average £651, double costs £860

- VSP has a high upfront cost in terms of hardware and subscriptions to software
- After these purchases, the only costing is the manufacture of 3D cutting guides etc, which can be offset against less lab time

Equipment Costs

- Traditional planning uses pre-made generic plates
- Plates must be bent by eye and hand to conform to patients' bone
- Many different suppliers – costs range from £200 + vat for a plate and screws kit up to north of £1000
- Different surgeons will prefer different manufacturers

- VSP allows for custom-made plates
- Should adapt to patients' anatomy perfectly
- Much more expensive – cost of plates and guides can reach over £2000

- One American study showed average total cost to patient of traditional vs custom plates was $7563 vs $31,250

Radiology

- Traditional planning requires a lateral cephalogram at £105 and multiple orthopantomograms at £63 each time
- VSP requires a CT of the head, particularly the mandible
- This is estimated to cost around as low as £160 up to £830

Post-Surgery Appointments

- Traditional planning then requires around 8 appointments for orthodontic refinement
- Total cost is around £1400 on average
- Total orthodontic appointment cost of £4550 on average

- VSP shows an expected 4 appointment reduction – another £700 saving
- Surgery first will then require 6-12 post-surgery visits – costing only £1575 in total on average

Traditional Operation

- Impressions taken of patient – potential source of error
- Stone models are poured and hand manipulated into occlusion or three-point landing – subjective
- Cuts on jaws are made by eye and by hand, measurements made with pencil and compass
- Plate position chosen at the time using OPT and eye to avoid important structures

VSP-led Operation

- Intra-oral scan taken of teeth, CT scan of maxilla and mandible
- Uploaded to software, movements planned
- Cutting guides and screw positioning jig fabricated
- Guides used for cuts, plates, screws
- Greatly reduced clinical time required – less operating time and costs

Cost Factors

- Studies show VSP can reduce the total planning and operative costs by 9.1 to 18.6%
- Hardware and software for VSP present front-loaded high costs, but is offset by reduction in lab personnel over time
- 3D-printed resin models can be expensive, but eliminate the intensive manual labour required with stone models
- Operating time is much shorter for VSP, significantly decreasing hospital costs

Further Planned Comparisons

- Surgeon preference – quality of wafers, ease of use, case difficulty
- Quality of labwork
- Results of Surgery – overjet and overbite correction, canine and molar classifications, centrelines, presence of cants, corrected per planning

What Next?

- Survey of surgeons already using system
- Business case
- Implementation of VSP in WHSCT